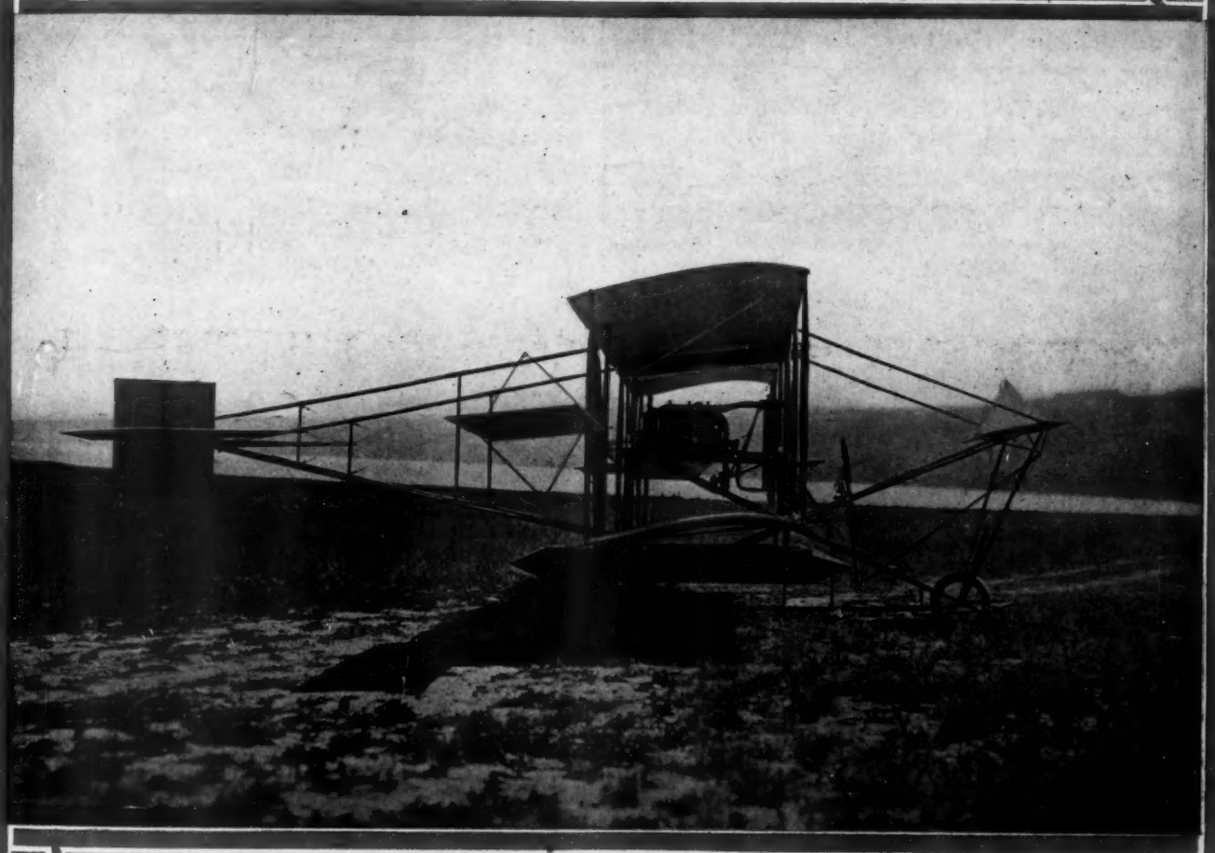
MAY 2, 1921 Issued Weekly PRICE 15 CENTS

AVIATION AND AIRCRAFT JOURNAL



The Original Amphibian: The First U. S. Navy Aircraft, a Curtiss "Triad" (July, 1911)

VOLUME X
Number 18

Four Dollars a Year

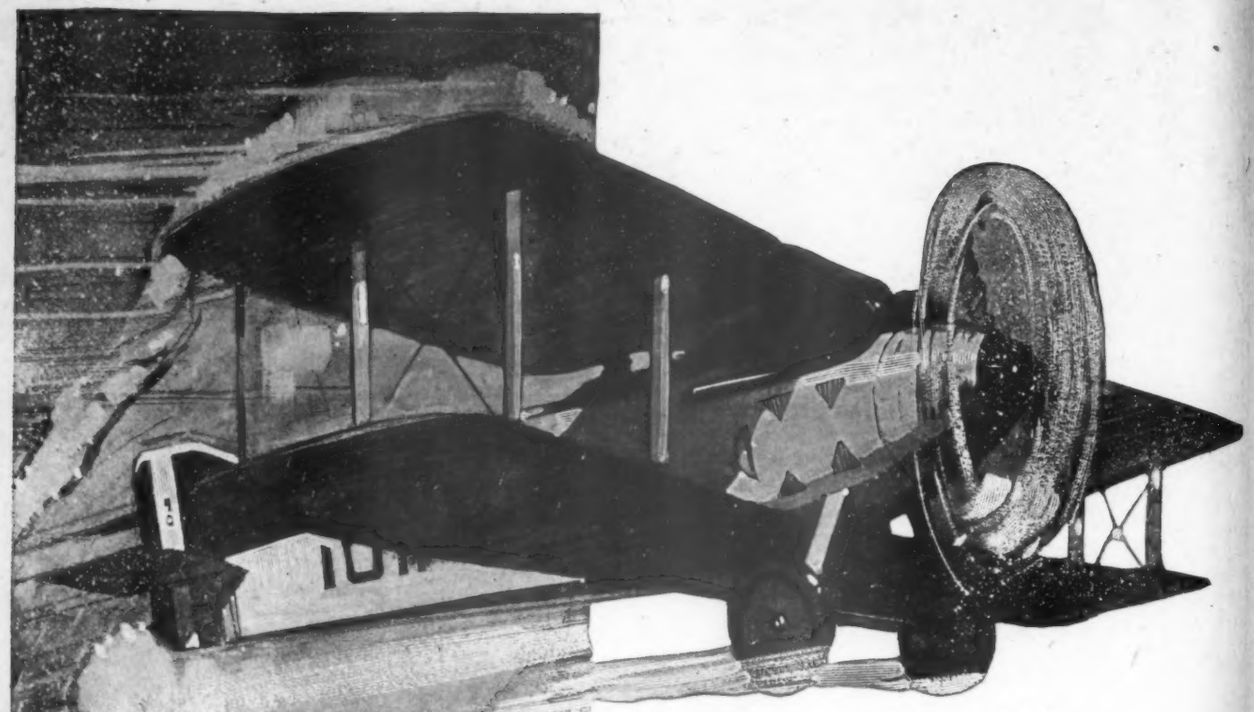
SPECIAL FEATURES

PRESIDENT SENDS AVIATION REPORT TO CONGRESS
THREE YEARS OF THE AIR MAIL
THE ULTIMATE AIRPLANE ENGINE
THE FOKKER COMMERCIAL EXPRESS

RECEIVED
MAY 5 1921
FIELD OFFICERS SCHOOL
LANGLEY FIELD, VA.

THE GARDNER, MOFFAT CO., INC.
HIGHLAND, N. Y.
225 FOURTH AVENUE, NEW YORK

Entered as Second-Class Matter, Nov. 22, 1920, at the Post Office at Highland, N. Y.



THE brilliant performance so characteristic of Wright Aeronautical Engines has made possible much of the new achievements in aeronautics.

This company with its ten year record of uninterrupted service in aeronautical development, is devoted to the single end of identifying its product with all that is constructive in this important industry.

WRIGHT AERONAUTICAL CORPORATION
PATERSON, N. J.

Wright Aeronautical Engine Model E 2. 180 H. P.

Member Manufacturers' Aircraft Association

WRIGHT AERONAUTICAL ENGINES

STANDARD MOTIVE POWER FOR ALL AIRCRAFT

FAITH

The Dayton Wright Company believes in aviation -- foresees with calm assurance the services which aircraft will render to Commerce and Industry.

It is pleased to consider that the opportunity to share in the development and in the accomplishment of its expectations of the aircraft industry is both a privilege and a trust.

Permit us to study your transportation problems. Probably you are one who may profit by the use of aircraft.

DAYTON WRIGHT COMPANY

DAYTON, OHIO, U. S. A.

"The birthplace of the airplane"

BOEING AIRPLANE COMPANY

Manufacturers of

EXCLUSIVELY DESIGNED

SEAPLANES

FLYING BOATS

AIRPLANES

CONTRACTORS TO UNITED STATES GOVERNMENT

GEORGETOWN STATION

SEATTLE WASHINGTON

Member of the Manufacturers Aircraft Association.

AVIATION AND AIRCRAFT JOURNAL

MAY 2, 1921 VOL. X. NO. 18

Member of the Audit Bureau of Circulations

INDEX TO CONTENTS

Editorials 551
Aviation Report of President to Congress 552
Dutch Airline Starts Operation 558
Three Years Air Mail 559
G. Elias Bros. Joins Manufacturers Aircraft Association 564
The Fokker Commercial Express Type C.II 565
The Ultimate Engine 567
Cruise of Navy Airboat Squadron 569
Air Mail Service in the Philippines 569
"Who's Who in American Aeronauties" 570
From Miami to Washington 572
Naval Airships for Commercial Uses 572

THE GARDNER, MOFFAT COMPANY, Inc., *Publishers*

HIGHLAND, N. Y.

225 FOURTH AVENUE, NEW YORK

SUBSCRIPTION PRICE: FOUR DOLLARS PER YEAR. SINGLE COPIES FIFTEEN CENTS. CANADA, FIVE DOLLARS. FOREIGN, SIX DOLLARS A YEAR.

COPYRIGHT 1921, BY T. E GARDNER, MOFFAT COMPANY, INC.
ISSUED EVERY MONDAY. FORMS CLOSE TEN DAYS PREVIOUSLY. ENTERED AS SECOND-CLASS MATTER NOV 22 1920, AT THE POST OFFICE AT HIGHLAND, N Y., UNDER ACT OF MARCH 3, 1897.

THOMAS-MORSE AIRCRAFT CORPORATION

Thomas-Morse Training 2-Seater in flight over Ithaca, N. Y.

THOMAS-MORSE AIRCRAFT CORPORATION

$400,000

BANKS deliver securities only by trusted messenger. Recently the newspapers stated that a Northern Bank making a heavy shipment of securities to a Southern State, sent them via airplane.

$400,000 worth of bonds, regularly insured, were delivered in record time.

The governing factors, on which the bank based its decision, were safety and speed.

From the very early days of flying, Glenn L. Martin airplanes have forged to the front and stayed there, because of their unequalled reputation for climbing ability, carrying capacity and sturdy endurance.

If the future success of your business is in any way dependent on quick and sure transportation, you are invited to write to us.

TRADE MARK

THE GLENN L. MARTIN CO.

CLEVELAND

Member of the Manufacturers Aircraft Association

TRADE MARK

L. D. GARDNER, PRESIDENT
W. D. MOFFAT, VICE-PRESIDENT
W. I. SEAMAN, TREASURER
GEORGE NEWBOLD, BUSINESS MANAGER

AVIATION AND AIRCRAFT JOURNAL

LADISLAS D'ORCY, EDITOR
ALEXANDER KLEMIN, TECHNICAL EDITOR
EDWARD P. WARNER, CONTRIBUTING H. T. A. EDITOR
RALPH H. UPSON, CONTRIBUTING L. T. A. EDITOR

Vol. X MAY 2, 1921 No. 18

Encouraging Aeronautical Engineers

THE Navy competition in which the preliminary awards have just been made marks a departure from previous governmental practice in that every effort was made to encourage the "outside designer" not affiliated with any producing company to submit designs.

Great as is the need of encouragement and assistance to the firms building airplanes it is of no less importance that designers and engineers be encouraged and that some incentive for continuing aeronautical work be given those who for one reason or another have not kept direct connection with the industry. It is not easy, as we have seen during the war, to improvise airplane factories in time of need, but it is even more difficult to improvise competent designing staffs, and the aeronautical engineer once trained should be regarded as a potential national asset. A continuance of the policy of holding design competitions entirely severed from any question of the actual construction of airplanes by the designers will be among the most effective means of causing those once engaged in airplane design, but now into other fields, due to the decreasing number of engineers needed by the present industry, to keep up with aeronautical developments and continue their work along that line, at least as an avocation.

Three Years of Air Mail Service

WHEN in the spring of 1918 the Post Office Department opened the Washington-New York air mail route, doubts were expressed as to the possibility of operating such a service during the winter. Three years have passed since and today the Air Mail not only operates all the year round, but it reaches from the Atlantic to the Pacific. New York is within 72 hours from San Francisco and even this time will be halved next summer when the Air Mail will run on a day-and-night schedule. It should not be forgotten that Otto Praeger will always have the credit of this pioneer work.

The U. S. Air Mail Service represents an achievement of which all Americans should feel proud. It started as a pioneer and it has remained a pioneer in furnishing daily practical demonstration of commercial aviation.

Lateral Control

IN spite of the great amount of aerodynamic data available and the numerous controllability tests conducted under fairly scientific conditions, the subject of lateral control is still shrouded in mystery and discussed in an empirical and unsatisfactory manner. One ship is said to have good lateral control because it was flown by a skilful pilot. Another ship is deemed as sluggish on the lateral control because it was tested by an inferior pilot. The good control of a machine, like the Fokker, is attributed to the fact that it uses a thick wing section, or that the control mechanism is efficient, or because the ailerons are placed over the center of gravity, or one or other more or less satisfactory guesses. While serious attention should be given to this subject in wind tunnel laboratories, it seems highly interesting to state at least the premises of the problem.

It is not sufficient to take a rough percentage of the wing area, place a rear spar in the position most suitable on the structural grounds, and end right there. We should consider first of all, whether the machine has its weights concentrated laterally, as the lateral moment of inertia will have an important bearing on the subject. Next we must see whether the aspect ratio is high or low. With a high aspect ratio the aileron arm is indeed larger, but the weight of the wing structure is proportionately more spread out, and the damping moment of the wings is likewise greater. We must consider whether the chord of the aileron is larger or smaller since the moment about the hinges of the ailerons will depend on this.

Then we must consider whether it is a thick or a thin wing that is under consideration, and determine whether the same style of aileron is suitable for both thick and thin wing sections.

We must also deal with the correct length of the aileron and whether it is best to make a short aileron with a large chord or a long aileron with a small chord. What is the efficiency of the aileron control at low angles of incidence? Does the controlling moment fall off in intensity at high angles of incidence? What is the yawing moment introduced by the ailerons for a given rolling moment? Is there any empirical data available for a single similar type of machine? Is there any aerodynamic data bearing on the subject? What is the maximum movement of the stick laterally and what are the leverages involved? What is the extent of the controllability required?

It will be seen from this that the apparently simple problem of proportion in the ailerons is in reality an exceptionally complex one.

New Aircraft Material

A NEW material which seems to have decided possibilities for aircraft construction has just appeared on the market. It is manufactured by cementing thin sheet metal faces to a relatively thick core of light weight material.

The construction is certainly ingenious and valuable. There may be some practical difficulties in applying the new material to aircraft construction, but it is readily conceivable that there would be a number of possible uses.

Imagine, for instance, a wing spar built up of this material. All the difficulties involved in securing metal flanges of the right shape, with the special dies and tools required, would disappear. At the same time, the local strength of the spar would be greatly increased as compared to a metal spar. The sheet metal would form a smooth, durable surface, and would reduce deterioration and fire hazard. For struts and longerons similar considerations would apply.

Aviation Report of President to Congress

Views of Minority of Special Committee Overruled in Report to President

What appears to be a most unfortunate obstacle to the working out of a broad aviation policy for the United States was revealed last week following the submittal to President Harding by Dr. C. D. Walcott of the "majority" views of a special subcommittee of the National Advisory Committe for Aeronautics.

The President requested Dr. Walcott as chairman of the National Advisory Committee, to appoint a subcommittee to report on the needs of aviation. The conclusions of the "majority" perpetuate the present bureaucratic system and recommends the creation of an additional bureau—a Bureau of Aeronautics in The Department of Commerce.

It is difficult to comprehend how in a time like this when the country needs not only adequate air defenses but an air policy, that a national body like the National Advisory Committee for Aeronautics should feel that it was not "desirable or permissible" to give the President the value of the experience and advice which he sought, from the minority as well as the majority members of the committee. This minority consisting of Glenn L. Martin, who ranks with the Wrights and Curtiss as one of the men the world is indebted to for pioneer work in aviation, Col. Walter G. Kilner, whose record as a pilot and Chief of all Air Service training overseas is unexcelled, Frank G. Russell, who started with the Wrights, was first manager of the Wright Co. and has been continuously in aviation since, and Col. Sidney D. Waldon, who was one of the leading officers of the Air Service during the war, could not represent better the well informed opinion of aeronautical experts.

They requested the subcommittee to consider the broader policies of a Department of the Air, a Unified Air Service or an Independent Air Force before going to the President with recommendations calculated to shape our destiny in the air.

The "minority" was overruled. In the final consideration of the majority report two civilian members were not present. One Army representative protested against rejection of all consideration of a broad policy and the third civilian, when further effort in the Committee as a whole appeared futile, presented, on behalf of the minority, a written report requesting Dr. Walcott to send to the President their urgent recommendation that an investigation of the broad policy be directed by him.

There follows the entire report, the minority report, telegrams and letters setting forth the situation as understood by the President, Dr. Walcott and Col. Waldon.

I

The President's Letter

THE WHITE HOUSE
Washington

April 1, 1921.

Dear Doctor Walcott:

It is desired that you immediately organize a subcommittee of the National Advisory Committee for Aeronautics, with representatives from the War, Navy, Post Office and Commerce Departments, and civil life; that the subcommittee take up vigorously and fully the question of Federal regulation of air navigation, air routes to cover the whole United States, and cooperation among the various departments of the Government concerned with aviation, reporting

a. What can and should be done without further legislative action;
b. What legislative action and appropriations are necessary to carry into effect the recommendations of the subcommittee.

Very truly yours,
(Signed) WARREN G. HARDING

THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

Photograph taken at the White House after interview with the President, April 21, 1921, the occasion being the semiannual meeting of the entire Committee, following close upon the approval by the President and transmission to Congress of a special report of the Committee outlining a new national aviation policy.

Reading from left to right: Mr. J. F. Victory, Assistant Secretary; Dr. M. I. Pupin, Columbia University; Mr. Orville Wright, Dayton, Ohio; Dr. Joseph S. Ames, John Hopkins University, Baltimore; Dr. William F. Durand, Leland Stanford Junior University, California; Mr. George W. Lewis, Executive Officer; Rear Admiral D. W. Taylor, Chief Constructor, U. S. Navy; Major T. H. Bane, Chief, Engineering Divisi n, Army Air Servi e; Dr. Charles D. Walcott, Chairman of Committee, Secretary of Smithsonian Institution; Major General Charles T. Menoher, Chief of Army Air Service; Captain William A. Moffett, Director of Naval Aviation; Professor Charles F. Marvin, Chief of the Weather Bureau; Dr. S. W. Stratton, Secretary of Committee, Director of Bureau of Standards; Professor John F. Hayford, Northwestern University, Evanston, Illinois.

II

The Minority Report

Major W. G. Kilner, F. H. Russell, Glenn L. Martin, and Sidney Waldon of the subcommittee are of the opinion that the President's letter justifies the consideration of a Department of the Air, a Unified Air Service or an Independent Air Force as a means to expedite the progress of the service of military, civil and commercial aviation. The majority over ruled them, however, and consequently the report contains no reference to that matter.

These members therefore urge that the President direct the National Advisory Committee for Aeronautics to investigate, with a view to making definite recommendation, as to the relative merits of

a. The situation as it will exist under the plan proposed in this report in which aeronautics will be divided among the Departments of War, Navy, Commerce and Post Office.
b. A Department of the Air.
c. A Unified Air Service.
d. An Independent Air Force.

April 8, 1921.

Dr. Chas. D. Walcott, Chairman:

We the undersigned request that the above be inserted in your report to the President in answer to his letter of April 1st, 1921.

W. G. Kilner, Major, Air Service
Sidney D. Waldon

III

Col. S. D. Waldon, replying to a telegram which read as follows: "Understand you did not sign Walcott Report. Minority report did not go to Congress. Please wire if you agree to majority report." states "Assisted in preparation of majority and minority reports. Doctor Walcott as Chairman signed majority report while four of us signed minority report. Both reports were forwarded by Doctor Walcott to the President and taken together represent the complete recommendations of the committee."

Sidney D. Waldon

IV

Dr. Chas. D. Walcott was sent the following telegram: "Minority Report of subcommittee does not appear in President's transmittal to Congress. Request wire today stating whether four in minority signed or agreed to your report and if their minority report is being sent to Congress by President."

Dr. Walcott replied as follows:

"The report as sent to the President was adopted without dissenting vote. There was no minority report but after the committee adjourned one member reported to me that he and three other members of the committee were of the opinion that the President's letter justified the consideration by the committee of the question as to whether a department of the air, a unified air service or an independent air force should be recommended. This matter has been discussed and in the opinion of the special committee the President's letter did not make it desirable or permissible to embark on such a discussion. However, all these facts were transmitted to the President."

Charles D. Walcott

V

The following request was sent to President Harding: "Report you transmitted Congress does not contain minority report of National Advisory Committee subcommittee. Understand these experienced aeronautical experts differ radically and did not sign Walcott Report. Request Secretary wire for publication whether or not this minority report is to be included." Geo. B. Christian, Jr., Secretary to the President, replied as follows:

"I am advised by the Assistant Secretary of the National Advisory Committee for Aeronautics that the sub-committee report, copy of which has been sent you, was adopted without dissenting vote."

Although Dr. Walcott states that it was not "desirable or permissible to embark in a discussion of a governmental agency as a means to expedite the progress of the science of military, civil and commercial aviation", the National Advisory Committee sent out the picture of the Committee reproduced in this issue with the following comment: "Photograph taken at the White House after interview with the President, April 21, 1921, the occasion being the semi-annual meeting of the entire Committee, following close upon the approval by the President and transmission to Congress of a special report of the Committee ***outlining a new national aviation policy.***"

It is significant that Col. S. D. Waldon, Major Walter G. Kilner, Glenn L. Martin and F. H. Russell, the signers of the minority report, were not invited to this meeting with the President.

The New York *Sun* which is usually regarded as an administration paper sums up the whole unfortunate matter in the following Washington despatch:

"Another upheaval in aircraft circles within and without the United States Government is under way here as a result of recommendations made to the President by Dr. Charles D. Walcott, chairman of the National Advisory Committee for Aeronautics. Dr. Walcott's report caused the President to recommend in his message to Congress what some flying men term a "most reactionary air programme."

The flying men are particularly incensed at Dr. Walcott for what they term an attempt to suppress the recommendations for a national flying policy made by a minority of the National Advisory Committee for Aeronautics.

When the President made his aircraft recommendations, flying men were astounded, they said, to find that he had counseled a policy that they consider was not in keeping with the demands of the time. Investigation indicated that only the majority report of the committee had been forwarded to the President. This was borne out later when the President sent the recommendations to Congress to be printed as a public document, for the printed document, which is No. 17, contains only the majority views.

Dr. Walcott denied today to *The Sun* correspondent that there had been any attempt to suppress the views of the minority of his committee in regard to aircraft recommendations."

The Report of the Comimttee follows. It is reported that the committee was so divided in its opinions that four separate reports were prepared before the final draft and even this draft was not agreed to by all the members of the subcommittee. It is significant to note that the date on the Report is April 9 while the date of the minority report is April 8.

SPECIAL REPORT OF THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

—Dealing with Federal Regulation of Air Navigation; Air Routes to Cover the Whole United States; Cooperation Among the Government Departments. Submitted to THE PRESIDENT OF THE UNITED STATES, April 9, 1921.

Dear Mr. President:

In accordance with your letter of April 1, 1921, addressed to Dr. Charles D. Walcott, Chairman of the National Advisory Committee for Aeronautics, this Committee organized a special Subcommittee on Federal Regulation of Air Navigation, as follows:

War Department: Maj. General C. T. Menoher, U. S A., Maj. W. G. Kilner, U. S. A.;

Navy Department: Rear Admiral D. W. Taylor, U. S. N., Commander Kenneth Whiting, U. S. N.;

Post Office Department: E. C. Zoll, C. I. Stanton;

Department of Commerce: Dr. S. W. Stratton, E. T. Chamberlain;

Repesentatives from Civil Life: Sidney Waldon, F. H. Russell, Glenn L. Martin;

Dr. Charles D. Walcott, Chairman. Mr. J. F. Victory, Secretary

This subcommittee has taken up, as you directed, the question of Federal regulation of air navigation, air routes to cover the whole United States, and cooperation among the various departments of the Government concerned with aviation, and, in addition, the two questions specified in your letter:

"a. What can and should be done without further legislative action;

"b. What legislative action and appropriations are necessary to carry into effect the recommendations of the subcommittee."

The report of this subcommittee is as follows:

The following general considerations on a national aviation policy are recommended:

1. Aviation is inseparable from the National Defense. It is necessary to the success of both the Army and the Navy. Each should have complete control of the character and operations of its own air service.
2. Aeronautics is a comparatively new science capable of such tremendous and rapid development that it is of vital importance, in time of peace, to make the greatest possible progress in the science itself. Everything should be done to stimulate invention and to encourage the practical use of aircraft of all kinds and of all the equipment and appliances necessary or incidental thereto.
3. It is considered impracticable in time of peace to maintain a large armed air force, but it is considered imperative that we maintain a sufficient nucleus of available personnel, including organized reserves, and of adequate equipment of the most modern type as a foundation upon which to build at the outbreak of war.
4. It is essential that commercial aviation be fostered and encouraged in harmony with the military and naval aviation policies and programs. The development of aviation as a whole will be made with the minimum of expense to the Government through the adoption of a wise and constructive policy for the up-building of commercial aviation.
5. The Air Mail Service is an important initial step in the development of civil and commercial aviation. It must be maintained and extended as rapidly as possible, not only to carry the mails but to become a potential war reserve.
6. It is a pressing duty of the Federal Government to regulate air navigation; otherwise independent and conflicting legislation by the various states will be enacted and hamper the development of aviation. For this purpose, a Bureau of Aeronautics should be established in the Department of Commerce, by legislation similar to the Kahn Bill as modified (see draft of bill taken from Sixth Annual Report of the National Advisory Committee for Aeronautics, Appendix A).
7. Approved policies with respect to the encouragement and development of commercial aviation should be carried out by the Department of Commerce.
8. The Army Air Service should be continued as a coordinate combatant branch of the Army. Its existing organization should be used in cooperation with the Navy, Post Office, and other governmental agencies in the prompt establishment of national continental airways and in cooperation with the states and municipalities in the establishment of local airdromes, landing fields, and other necessary facilities.
9. The Naval Air Service and the control of naval activities in aeronautics should be centralized in a Bureau of Aeronautics in the Navy Department.
10. The continuous prosecution of scientific research in aeronautics is now provided for by the National Advisory Committee for Aeronautics, established by law in 1915, and broad questions of policy regarding the coordination of the activities of all governmental agencies concerned with aeronautics should be referred to that committee for consideration and recommendation.
11. The National Advisory Committee for Aeronautics should have authority to recommend to the heads of the departments concerned on questions of policy regarding the development of aviation, and to recommend to departmental heads desirable undertakings or developments in the field of aviation. To provide for the more effective discharge of these functions, the chief of the Air Mail Service of the Post Office Department and the chief of the proposed Bureau of Aeronautics in the Department of Commerce should be members of the committee.
12. Under this policy, there would be
    An Army Air Service under the Secretary of War;
    A Naval Air Service under the Secretary of the Navy with its activities centralized in a Bureau of Aeronautics in the Navy Department;
    An Air Mail Service under the Postmaster General;
    A Bureau of Aeronautics for the regulation of air navigation, under the Secretary of Commerce, and for carrying out such policies as may be adopted for the encouragement and up-building of civil and commercial aviation;
    A National Advisory Committee for Aeronautics for the continuous prosecution of scientific research in aeronautics, and, in an advisory capacity, the coordination of all aeronautical activities of the Government.

Referring specifically to the detailed questions under the three headings, namely,

1. Federal Regulation of Air Navigation,
2. Air Routes to Cover the Whole United States,
3. Cooperation among the Various Departments of the Government Concerned with Aviation;

the committee reports as follows:

1. FEDERAL REGULATION OF AIR NAVIGATION

(a) Federal regulation of air navigation cannot be accomplished under existing laws. Smuggling and other illegal uses of aircraft can be prevented in a measure.

(b) It is recommended that a Bureau of Aeronautics be established in the Department of Commerce (substantially along the lines of the Kahn Bill as modified) for the regulation of air navigation and for carrying out such policies as may be adopted for the encouraging and upbuilding of civil and commercial aviation and that an estimate of $200,000 be submitted for the fiscal year 1922.

2. AIR ROUTES TO COVER THE WHOLE UNITED STATES

(a) The Post Office Department is specifically authorized to establish an air route between New York and San Francisco. There is some question as to whether existing laws permit it to establish other routes.

The Army has no specific authority of law to establish air routes, but has charted seven important main airways as follows:

1. One route from Augusta, Maine, to Camp Lewis, Washington;
2. One from Washington, D. C., to San Francisco, California;
3. One from Savannah, Georgia, to San Diego, California;
4. One from Augusta, Maine, to Miami, Florida;
5. One from Camp Lewis, Washington, to San Diego, California;
6. One from Laredo, Texas, to Fargo, North Dakota;
7. One from Chicago, Illinois, to Baton Rouge, Louisiana.

(Appendix B shows these routes.)

(b) In order to enable the Army to carry forward its program of air routes to cover the whole United States, it is recommended that an appropriation of $2,000,000 be made available during a period of two years.

Attention is drawn to "Necessary Aerological Service and Estimate of Costs," Appendix C. It is recommended that such portions of the appropriations asked for as are necessary to give aerological service on the approximately 4,000 miles of air mail routes now in commission be made available, and that the funds to cover additional stations along the national continental air routes to cover the whole United States be made available as fast as the need is indicated by the Army and the Post Office Department.

It is recommended that legislation be enacted which will definitely authorize the Post Office Department to establish air mail routes between Chicago, Minneapolis, and St. Paul, and between Chicago and St. Louis, and such other air mail

routes as may be determined by the Postmaster General as the need of them arises, taking full advantage, wherever practicable, of existing or contemplated airways.

3. COOPERATION AMONG THE VARIOUS DEPARTMENTS OF THE GOVERNMENT CONCERNED WITH AVIATION

(a) Cooperation among the air services of the Army, Navy and Post Office with the Coast and Geodetic Survey, Bureau of Fisheries, Coast Guard, Weather Bureau, Geological Survey, and Forest Patrol Service, is being carried on with excellent results, as shown in Appendix D.

It is recommended that the President direct the National Advisory Committee for Aeronautics to appoint a subcommittee composed of representatives of the War, Navy, Post Office, and Commerce Departments, and two civilians representing the aircraft industry who shall survey the engineering and production facilities of the aircraft industry and shall recommend a policy calculated to sustain and develop the industry to meet the needs of the Government.

(b) Attention is drawn to the memorandum on forest fire patrol, Appendix E. It is recommended that the funds ($217,151.00) and personnel asked for be made available for the purpose specified.

In summing up this report, permit me to emphasize the immediate need of legislation to provide for

1st, A Naval Air Service under the Secretary of the Navy, with its activities centralized in a Bureau of Aeronautics in the Navy Department.

2d, A Bureau of Aeronautics under the Secretary of Commerce for the regulation of air navigation and the encouragement and up-building of civil and commercial aviation.

3d, The development of a system of national continental air routes to cover the whole United States and to include the meteorological service essential thereto.

4th, The extension of the Air Mail Service.

5th, Making the chief of the Air Mail Service and the chief of the proposed Bureau of Aeronautics of the Department of Comemrce members of the National Advisory Committee for Aeronautics.

Respectfully submitted,

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
(Signed) C. D. Walcott,
Chairman.

The President,
The White House,
Washington, D. C.

---

* Appendix A is the modified Kahn Bill as shown on Pages 11-14 of Sixth Annual Report, National Advisory Committee for Aeronautics, and is not reproduced here.

APPENDIX B*

CONTINENTAL AIRWAYS AND APPROXIMATE COSTS

By Air Service of the Army

Seven important main airways have been charted, and by utilizing Government airdromes already existing, these airways make the air net complete for the United States.

One route from the State of Maine to the State of Washington covers the following stations:

Augusta, M.—Municipal.
Plattsburg, N. Y.—Government, not A. S.
Binghamton, N. Y.—Municipal.
Buffalo, N. Y.—Private.
Cleveland, Ohio—Private.
Detroit, Mich.—Air Service.
Bryan, Ohio—Municipal.
Chicago, Ill.—Government, not A. S.
Winona, Minn.—Municipal.
St. Paul, Minn.—Government, not A. S.
Fargo, N. Dak.—Municipal.
Portal, N. Dak.—Municipal.
Miles City, Mont.—Government, not A. S.
Missoula, Mont.—Municipal.
Spokane, Wash.—Private.
Camp Lewis, Wash.—Government, not A. S.

One transcontinental route from Washington, D. C., to San Francisco, Calif.:

Bolling Field, Anacostia, D. C.—Air Service.
Moundsville, W. Va.—Municipal.
Dayton, Ohio—Air Service.
Speedway, Indianapolis, Ind.Air Service.
Rantoul, Ill.—Air Service.
Des Moines, Iowa—Municipal.
Omaha, Nebr.—Government, not A. S.
Hastings, Nebr.—Municipal.
St. Paul, Nebr.—Municipal.
Cheyenne, Wyo.—Government, not A. S.
Rawlins, Wyo.—Municipal.
Salt Lake City, Utah—Municipal.
Elko, Nev.—Municipal.
Sacramento, Calif.—Air Service.
San Francisco, Calif.—Air Service.

One route from Savannah, Ga., to San Diego, Calif.:

Savannah, Ga.—Municipal.
Camp Benning, Ga.—Air Service.
Montgomery, Ala.—Air Service.
Baton Rouge, La.—Municipal.
Lake Charles, La.—Municipal.
Houston, Tex.—Air Service.
San Antonio, Tex.—Air Service.
Del Rio, Tex.—Air Service.
Sanderson, Tex.—Municipal.
El Paso, Tex.—Government, not A. S.
Douglas, Ariz.—Government, not A. S.
Tucson, Ariz.—Municipal.
Phoenix, Ariz.—Municipal.
Yuma, Ariz.—Government, not A. S.
San Diego, Calif.—Air Service.

One route north to south on the Atlantic Coast:

Augusta, Me.—already mentioned.
Boston, Mass.—Municipal.
Mitchel Field, L. I.—Air Service.
Bustleton, Pa.—Government, not A. S.
Aberdeen, Md.—Air Service.
Baltimore, Md.—Municipal.
Washington, D. C.—Air Service.
Langley Field, Va.—Air Service.
Camp Bragg, N. C.—Air Service.
Camp Jackson, S. C.—Air Service.
Savannah, Ga.—already mentioned.
Jacksonville, Fla.—Government, not A. S.
Daytona, Fla.—Municipal .
Carlstrom Field, Fla.—Air Service.
Miami, Fla.—Air Service.

One route along the Pacific Coast:

Camp Lewis, Wash.—already mentioined.
Portland, Ore. —Municipal.
Red Bluffs, Calif.—Government, not A. S.
Sacramento, Calif.—already mentioned.
Fresno, Calif.—Private.
Riverside, Calif.—Air Service.
San Diego, Calif.—already mentioned.

One middle route from north to south:

Laredo, Tex.—Air Service.
San Antonio, Tex.—already mentioned.
Dallas, Tex.—Air Service.
Waco, Tex.—Municipal.
Witchita Falls, Tex.—Municipal.
Post Field, Okla.—Air Service.
Little Rock, Ark.—Municipal.
Tulsa, Okla.—Private.
Leavenworth, Kans.—Government, not A. S.
Omaha, Nebr.—Government, not A. S.
Aberdeen, S. Dak.—Municipal.
Fargo, N. Dak.—already mentioned.

One route from the Lakes to the Gulf:

Chicago, Illinois—already mentioned.
Chanute Field, Rantoul, Ill.—Air Service.
Belleville, Ill.—Air Service.
Millington, Tenn.—Air Service.
Jackson, Mississippi—Municipal.
Baton Rouge, La.—already mentioned.

In the establishment of these airways, it is found that the various municipalities are usually glad to contribute the actual landing fields if the Federal Government will furnish the

necessary equipment to operate such a field. The installation provided will depend largely upon the number of Reserve personnel in the immediate vicinity that would rely upon this installation for their flying training.

The type installation is as follows:

1 Wing cone with proper support and field marker T	$ 150
1 Well with pump, 100 gallon tank	1,000
1 Building 25 ft. by 100 ft. to contain the field office lockers, meteorological office and emergency hospital and for use as a machine shop, supply storage and work room	25,000
1 Oil tank, approximately 500 gal., with pump	750
1 Oil house, ten feet square	850
1 Gas tank with approximately 1000 gal. capacity, with pump	1,000
1 Hangar, steel, size 66 ft. by 120 ft. with steel folding or sliding doors and cement floors	35,000
	$63,750

It will be noted that in this type installation only one hangar is furnished. In many cases it will be necessary to have at least three hangars. In centers like Philadelphia and Boston this means the addition of $70,000 to the above amount.

It is estimated that to establish completely this proposed net would cost approximately $2,000,000. In the estimate for the Fiscal Year 1922 there was requested $1,000,000 as a start on this proposed scheme. It was desired to begin with the most important centers such as Boston, Philadelphia, Baltimore, Chicago, St. Paul, Minn., Denver, Col., Kansas City, and Seattle, Washington.

APPENDIX C

Necessary Aerological Service and Estimate of Costs

A rational development of any program of navigation of the air must recognize meteorology and weather forecasting as a fundamental factor of great importance. The Weather Bureau was originally created by Joint Resolution of Congress aproved Feb. 9, 1870, placing the organization under the Chief Signal Officer of the Army, in the War Department, where it remained and developed for a period of about twenty years.

Organic Act

The Joint Resolution was superseded by legislation entitled:

> "An Act to increase the efficiency and reduce the expenses of the Signal Corps of the Army, and to transfer the Weather Service to the Department of Agriculture." (Act Oct. 1, 1920, c. 1266, 266 Stat. 653.)

This organic act became effective July 1, 1891, and defines and outlines the functions and duties of the Weather Bureau very comprehensively and fully in the following language:

> "Sec. 3. That the Chief of the Weather Bureau, under the direction of the Secretary of Agriculture, on and after July first, eighteen hundred and ninety-one, shall have charge of the forecasting of weather, the issue of storm warnings, the display of weather and flood signals for the benefit of agriculture, commerce, and navigation, the gauging and reporting of rivers, the maintenance and operation of sea coast telegraph lines and the collection and transmission of marine intelligence for the benefit of commerce and navigation, the reporting of temperature and rainfall conditions for the cotton interests, the display of frost and cold-wave signals, the distribution of meteorological information in the interests of agriculture and commerce, and the taking of such meteorological observations as may be necessary to establish and record the climatic conditions of the United States, or as are essential for the proper execution of the foregoing duties."

With the practical development of navigation of the air a new demand was at once made upon the Weather Bureau for service in aid of aviation, and it is construed that the words of the organic act "for the benefit of agriculture, commerce and navigation" obviously includes navigation of the air as well as of the oceans and inland waterways. Congress itself has in effect subscribed to this construction of the law, because in 1917 an apropriation was made for the conduct of this work under the following language:

> "For the establishment and maintenance by the Weather Bureau of additional aerological stations, for observing, measuring and investigating atmospheric phenomena in the aid of aeronautics, including salaries, travel, and other expenses in the city of Washington and elsewhere."

This appropriation was first included in the act making appropriation for the support of the Army for the fiscal year ending June 30, 1918, and has subsequently been continued in the annual appropriation bills for the Weather Bureau of the Department of Agriculture.

Authority of Law now Adequate

It is believed the foregoing completely establishes that the Weather Bureau has full existing authority of law for the conduct of meteorological work of every character required for aeronautics, and under these laws the Bureau has been conducting as large a program of work as is possible with the funds available.

Meteorology and Weather Forecasting a Unit

In the organization of Government operations and activities with reference to meteorology and aviation, it is deemed to be a fundamental proposition that the whole problem of meteorological advices and warnings constitute a unit, for this service can only be administered when a comprehensive system of observations are available from a network of stations furnishing the fullest possible data concerning the conditions of the atmosphere, not only over the continents but over the oceans at all altitudes accessible.

On this principle, prior to the war the Weather Bureau received, by international cooperation, reports from the entire Northern Hemisphere, and published a daily weather map of the same. This service, suspended by the war, is now only partly restored. For fifty years the Weather Bureau has been an essential unit dealing with meteorology. Segregation of essential functions and activities, or the assignment of portions of its work to other organizations, cannot be accomplished without loss of efficiency or great increase in cost and duplication and conflict of effort, because the fundamental system of complete observations and reports must be available for study and application by an agency attempting to furnish advices and forecasts.

Policy and Program

Any program of meteorological work in aid of aeronautics is necessarily very intimately associated and interlocked with general meteorological work, forecasts, warnings and advices of every character. For this service it is fundamentally essential to maintain a comprehensive network of stations over the entire continental area of the United States from which observations and reports are regularly and systematically received, including observations of the free air. Where practicable by international cooperation and otherwise, such reports must be supplemented by reports from the other continents and the oceans.

In the specific interests of aviation this system of stations must include stations for the making of observations in the free air by the use of kites, balloons and other agencies. At present only six completely equipped stations are in operation, supplemented by a small number of stations at which only pilot balloon observations are made. Reports furnish twice daily the direction and velocity of motion of the free air in different altitudes at from about 500 meters to about 3000 or 4000 meters above the surface of the earth. Results are telegraphed promptly to Washington twice a day and are used in furnishing daily forecasts and warnings which are sent to the aviation branches of the Army, the Navy, the Post Office Department, aeronautical clubs, and all civilian interests who can utilize and desire the advices and information.

Present appropriations. The amount of money expended for all purposes identified immediately with the exploration

of the free air is at present $81,020, this being the total of the appropriation for the year 1920-21. For 1921-22 the same appropriation, $81,020, is available.

The above sum is supplemental to the general appropriations of the Weather Bureau for all purposes, and the general resources of the Weather Bureau are of course available to supplement the actual sum appropriated for aviation purposes.

Results Now Being Obtained

Prior to 1917 the Weather Bureau conducted a single observation station for the exploration of the upper air and published results of these observations more or less in detail in the Bulletins of the Mount Weather Observatory. Subsequently it issued a five-year summary of these observations, giving details of upper air conditions. These results are very valuable and were greatly in demand by artillerists, aeronauts and others during the period of the war and were quoted and referred to in connection with a great many problems dealing with free air conditions. Upon the establishment of five additional kite stations the observational data began to be published as promptly as possible in the Supplements of the Monthly Weather Review, which also were in demand and used during the period of the war. From lack of funds the publication of the Supplements had to be suspended, but the free air data are being analyzed and studied, and a three-year summary from the six aerological stations is in process of compilation. A considerable number of special studies of free air phenomena as shown by observations have been made and the results published in the Monthly Weather Review. Systematic forecasts of conditions for aeronauts were announced to begin Dec. 1, 1918. These have been continued ever since and very considerably extended. The whole service of the Weather Bureau in aid of aviation is in a plastic form, subject to change and development as experience and needs indicate. Specific service was rendered in connection with the trans-Atlantic flights, both of the NC-4 and the British airship R-34, and on every occasion of any aeronautical event the weather Bureau has been alert to make its advices and information directly available and beneficial in every way possible.

Proposals for Development

Progress in the meteorological science and its applications requires an accumulation of observational data of atmospheric phenomena and conditions over a considerable period of time.

Additional stations needed. Eight primary stations should be established at the earliest possible date, to bring the total up to fourteen. Including the cost of equipment, salaries, telegraphing, and summarizing the results, these stations would require an annual expenditure of about $22,500 each. The total cost for the eight stations, annually, would be $180,000. At least one additional station should be established each ensuing year until a total of twenty primary stations for the entire United States has been secured.

Actual Meteorological Service Along Air Routes

Whenever an air route for regular traffic is established, the meteorological service necessary for that particular route should be set up even in advance of the time the air route is in actual practical operation. For each 1000 miles of independent airway established and put in more or less complete operation the Weather Bureau should maintain a concentrated service of such route. This will require supplemental stations at intervals of about 250 miles, and the plan comprehends even additional reports from cooperative observers at intermediate points, giving visibilty, local cloudiness, squalls, etc., so that at any time an aviator along the route would know the actual conditions at places toward which he may be flying. The cost of establishing and fully maintaining and operating these stations at intervals of 250 miles is estimated at $5,000 each, or a total of $25,000 for each independent 1000 miles of air route. At the present time there are approximately 4000 miles of air routes authorized and in more or less regular operation. Meteorological reports and information are now needed for these aeronautical operations. In addition, flying is practiced more or less regularly over additional courses also needing the benefits of meteorological advices and warnings.

Summary

The appropriations estimated to be necessary to meet the present and prospective requirements of aeronautics within the next five years are as follows:

For primary eight stations essential to fundamental studies of conditions in the free atmosphere	$180,000
Secondary stations for 4,000 miles of authorized air routes and for special and supplementary flying	220,000
Total	$400,000
ANNUAL EXTENSIONS	
One additional primary station per year for six years or until six are added	$ 22,500
Supplementary stations along established air routes for each 1000 miles of continuous airway	20,000
	$42,500

APPENDIX D

Cooperation among the Various Departments of the Government Concerned with Aviation

War and Navy Departments

The cooperation between the Air Services of the the Army and Navy Departments is provided by a Joint Army and Navy Aeronautical Board, whose duty is to prevent duplication and to secure coordination in the construction of aircraft experimental stations and all operating air stations used by the Army, Navy or both. All questions relating to the development of new types of aircraft and weapons to be used by aircraft are referred to the Aeronautical Board to determine which Department should properly be charged with its development. All matters of procurement and purchase of aircraft and the estimates for the appropriations for the Army and Navy aviation programs are presented to this Board for review and recommendation before submission to Congress. Training facilities are interchanged and existing law provides for the interchange of material.

War, Navy and Post Office Departments

The War, Navy, and Post Office Departments cooperate extensively in the following ways: Surplus aeronautical equipment in possession of the Army or Navy for which the Post Office Department has a definite use is transferred freely; the Post Office Department having the opportunity to obtain this material before it is offered for sale. Air Mail stations, especially those on the New York-San Francisco Airway, are used by the Army and Navy, and in turn the Air Mail Service has the use of the Army fields, repair depots and the facilities of the Naval Aircraft Factory. Army, Navy and Air Mail pilots in distress may obtain assistance and supplies from the air stations of each Department without discrimination. There is complete interchange of technical and engineering data, operating reports and general information. In addition, the Air Mail pilots and mechanics must have passed the Army or Navy aviation physical examination and in case of questions as to the physical fitness of any air mail pilot or mechanic he is re-examined by the Military or Naval Air Service Medical Departments. Other Governmental agencies such as the Bureau of Standards, Bureau of Mines and Weather Bureau render the technical assistance for which they are especially fitted.

Experimental and Research Development

Coordination of experimental and research work is provided for by the subcommittees of the National Advisory Committee for Aeronautics. The organization of the National Advisory Committee for Aeronautics provides for subcommittees of Power Plants for Aircraft, Materials for Aircraft, and Aerodynamics. Each department of the Government, as well as the different branches of the aircraft industry, are

represented in the membership of the various subcommittees. The proposed and active research and experimental development of each governmental department is reported to the subcommittees, thus preventing unnecessary duplication. The subcommittees further provide means of exchange of information and ideas which permits the industry and the various departments to familiarize themselves with the research that is in progress.

Navy and Department of Commerce

(*a*) *Geodetic Survey.* The Air Service of the Navy is now engaged in mapping the Mississippi Delta for the Coast and Geodetic Survey, and has completed the mapping of swamps in South Carolina for the same service.

(*b*) *The Bureau of Fisheries.* The Navy has demonstrated to the Bureau of Fisheries the practicability of locating schools of fish and reporting their location to fishermen. This service has been extended to the point where it was shown that it would be practicable to maintain an airplane service for this purpose.

Navy and Treasury Department

(*a*) *Coast Guard.* The Navy Air Service has cooperated with the Coast Guard in the training of pilots and the transfer of equipment to this organization.

Navy and Department of Agriculture

(*a*) *Weather Bureau.* The Weather Bureau has cooperated to the extent of its facilities in providing meteorological information to the Navy. A meteorological interdepartmental committee has been organized to coordinate the needs and services of all of the governmental departments operating airplanes.

War Department and Department of Agriculture

(*a*) *Forest Service.* An aerial survey is being made of the recent Olympic blow-down of the State of Washington where over 8,000,000,000 board feet of timber has been destroyed. Forest Fire Patrol will be continued and will require approximately 1,000,000 miles of flying per year.

(*b*) *Bureau of Farm Management.* Photographs have been made of agricultural districts in order to obtain photographs by means of which farm management and development may be improved.

(*c*) *Bureau of Entomology.* Various areas have been photographed for the Bureau of Entomology and experiments are being made for the purpose of locating rust spores in the upper air currents.

(*d*) *Weather Bureau.* The Air Service has cooperated with the Weather Bureau in various capacities, especially in connection with obtaining meteorological information.

War Department and Treasury Department

Aerial photographs of various areas are being made for the use of the United States Public Health Service.

War Department and Department of the Interior

Geological Survey. Geological surveys are being made of various areas such as Bibb County, Ga., Greater New York, New York Harbor, 2708 square miles in North Carolina, some 4000 square miles in the vicinity of Los Angeles, and many other areas totalling some 20,000 square miles. For the same department the Air Service is cooperating with the Director of National Parks and the Chief of the Reclamation Service.

War Department and Department of Commerce

Coast and Geodetic Survey. Areas near the head of the Chesapeake Bay, Atlantic City and Florida Reefs are being photographed from the air, also the coast of New Jersey, from Cape May to Sandy Hook. By means of aerial photographs revision of the charts of the James River from Hampton Roads to Richmond and the coast lines of South Carolina, Georgia and Florida are being accomplished. Aerial photographs of various forest areas, public buildings, rivers, and cities are being taken whenever facilities become available. Among the important examples of this type of work may be quoted: forest areas of the Adirondack region and the State of Pennsylvania, public buildings and grounds of the District of Columbia, 1200 miles of the Red River basin between the States of Oklahoma and Texas, and the Tennessee River Basin. Photographs for the Secretary of the Commission of Fine Arts are being made to aid him in planning the new botanical gardens.

APPENDIX E
COOPERATION OF WAR AND AGRICULTURAL DEPARTMENTS AND OPERATING

COST OF FOREST FIRE PATROL

These figures do not include the overhead, such as cost of initial equipment of airplanes nor personal expenses and salaries of operating personnel, which are covered in the specific Army appropriations for that purpose.

(A) Year 1921. Program covering California and Oregon alone.

Estimate of actual money expended:

(a)	Maintenance of airplanes and their spare parts, 37 planes at $200 per plane ..	$ 7,400.00
(b)	Maintenance of engines and their spare parts, 50 engines at $200 each	10,000.00
(c)	Fuel and oil, based on 28 gallons per hour at $.35 per gallon, and 1½ gallons of oil at $1.00 per gallon,	
	Gasoline	35,660.80
	Oil	5,994.00
		$59,054.80

(B) Estimate for fiscal year 1922. Extended forest fire patrol.

(This program will not be carried out due to lack of—

(a) Appropriations

(b) Personnel

(c) Instructions from General Staff adopting first alternative (that is, a reduction) of the three alternatives set forth.

This would allow the Forest Fire Patrol to include Washington, Idaho, Montana and a small portion of Wyoming, a total of five squadrons, 160 officers and 660 enlisted men.)

Estimated Cost;

(a)	Maintenance of airplanes and their spare parts	$ 54,026.00
(b)	Maintenance of engines and their spare parts	47,253.00
(c)	Cost of fuel and lubricants	115,872.00
	Total	$217,151.00

NOTE—This does not include the appropriation of $50,000 obtained by the Department of Agriculture for cooperation with the Air Service and forest fire protection and expended under the supervision of the Department of Agriculture and its officers.

Dutch Air Line Starts Operation

On Apr. 15 the air mail and passenger service between London and Holland, with through connections to Northern Germany and Scandinavia, reopened. The Royal Dutch Air Transport Co., (better known as the K.L.M. from the initials of its Dutch name) carried out these services last year with chartered English machines. They have now, however, purchased a fleet of Fokker commercial airplanes, as it was found impossible to conduct passenger services with converted war machines, which carried insufficient loads to pay their way and did not provide sufficient comfort. The machines now used are the new Fokker F.III type monoplanes, which have 220 hp. B.M.W. or 240 hp. Siddeley engines and carry in a comfortable cabin, five passengers, with their baggage, at a speed of 105 m.p.h.

It is stated that the Dutch company intends to extend the services from London to Southampton, Plymouth and Liverpool in order to enable passengers arriving from America to immediately continue their journey to Paris, Brussels, Amsterdam, Berlin or Copenhagen by air. An office may be opened in New York so that reservations may be made in advance.

Three Years of Air Mail Service

The United States Air Mail Service will complete its third year of operation on May 15, 1921, with more than 2,250,000 miles of flying to its credit. In this period the Air Mail Service will have carried more than 80,000,000 letters, or an equivalent of approximately 2,000,000 lb. of mail, and covered 87 per cent of its scheduled mileage, based on its performance up to March 15, 1921.

A Comparison of Performances

This work has not been accomplished without the usual sacrifice connected with aviation, but the accompanying table shows that the United States Air Mail Service has a better safety record than commercial aviation in Great Britain or in Canada. This record shows one fatality in the Air Mail Service for each 97,826 miles flown, against one fatality for each 81,894 miles flown in England, and one fatality for each 73,744 miles flown in Canada.

The Air Mail record covers a period of 36 months, the British record covers 20 months, and the Canadian record is for a period of 9 months. The work of the Air Mail Service, except for a small amount of test flying consists entirely of cross-country flying over great distances, whereas the British and Canadian air enterprises operate over very short distances. The Air Mail Service operates the longest airway in the world, the distance between New York and San Francisco being 2,630 miles, while the longest British airway, from London to Paris, is only 240 miles long. No airway is operated on schedule in Canada.

The table of comparative performances of the United States Air Mail Service and of British Canadian civil flying follows:—

COMPARATIVE TABLE OF PERFORMANCE OF THE UNITED STATES AIR MAIL, AND OF BRITISH AND CANADIAN CIVIL FLYING

Service	*Miles flown*	*Period (months)*	*Fatalities*	*Miles per Fatality*
U. S. Air Mail	2,250,000	36	23	97,826
British	1,556,000	20	19	81,894
Canadian	442,462	12	6*	73,744

* The Canadian Air Board report on civil flying does not disclose the actual number of fatalities but reports five accidents in which "one or more occupants of the airplane" were killed. The smallest possible number of fatalities (6) is therefore used in this comparison.

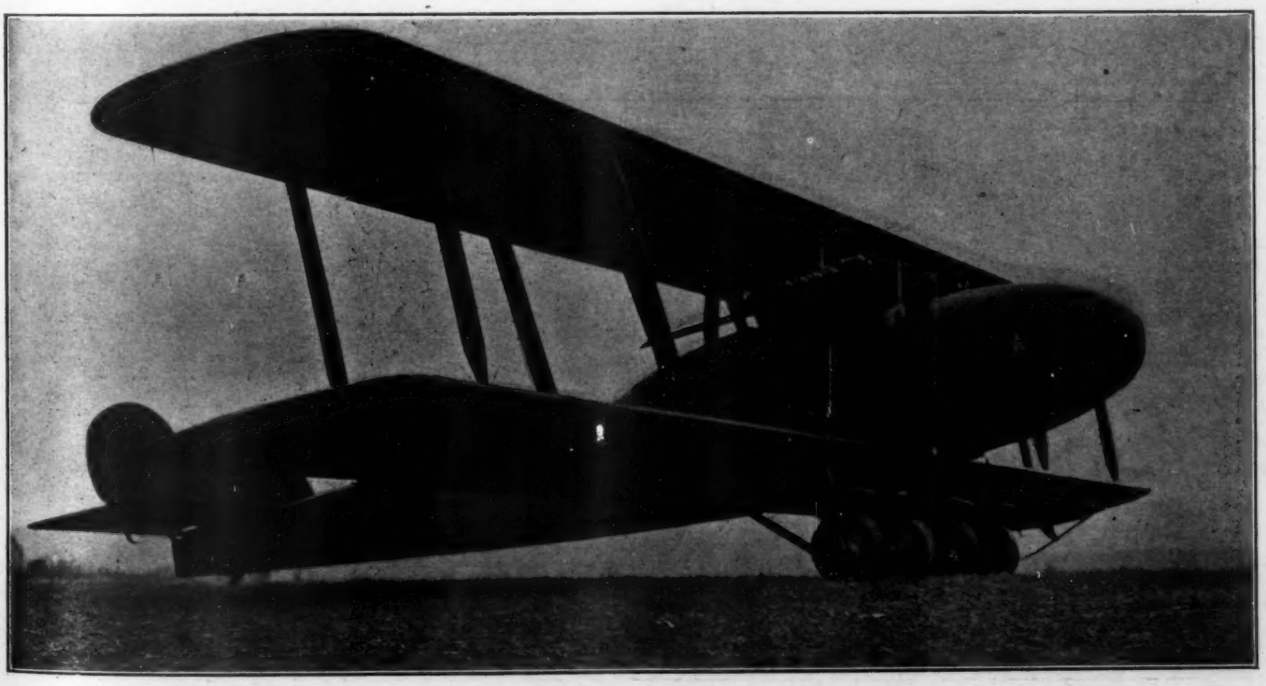
Following are given various tables indicating the performance, length of routes, number of airplanes and engines in service and in reserve, fatalities, forced landings, per mile cost and schedules of the United States Air Mail Service to date of March 15, 1921, unless otherwise indicated.

CONSOLIDATED STATEMENT OF PERFORMANCE

MAY 15, 1918 TO MARCH 15, 1921

MONTH	Miles Flown With Mail	Percentage of Performance	Pounds of Mail	No. of Pieces	Cost of Service
1918					
May	5,324	78.87	4,750	190,000	$3,682.11
June	10,685	94.97	13,081	523,240	9,922.71
July	11,855	97.57	16,967	678,680	10,001.46
August ...	11,984	99.96	16,588	663,520	9,555.67
September .	10,900	100.00	15,200	608,000	9,638.74
October ...	11,617	98.68	16,788	671,520	9,841.76
November .	11,118	98.07	16,854	674,160	10,673.68
December .	8,415	77.23	17,778	711,120	13,300.46
1919					
January ..	9,653	82.00	18,105	724,200	13,741.58
February .	9,307	88.18	15,489	619,560	13,645.16
March	10,699	92.59	17,531	701,240	13,880.29
April	11,105	95.06	16,677	667,080	13,516.44
May	22,578	96.92	26,627	1,065,080	17,715.66
June	30,835	99.53	35,647	1,425,880	30,891.62
July	56,577	96.04	48,704	1,948,160	41,134.38
August ...	58,022	98.43	56,870	2,274,800	40,614.59
September .	56,308	98.60	55,668	2,226,720	34,861.53
October ...	50,436	86.27	55,095	2,203,800	35,609.03
November .	41,757	86.61	54,084	2,163,360	31,127.58
December .	35,788	73.61	41,246	1,649,840	33,909.86
1920					
January ..	33,952	69.83	43,125	1,725,000	52,551.66
February .	32,647	71.02	37,242	1,489,680	46,004.12
March	37,861	77.25	42,361	1,694,440	44,785.71
April	41,890	86.16	42,066	1,682,640	55,343.40
May	54,138	90.72	51,112	2,044,480	57,004.83
June	49,867	69.74	59,005	2,360,200	80,209.43
July	69,140	96.69	68,401	2,736,040	85,993.59
August ...	73,455	92.42	73,140	2,925,600	73,026.93
September .	105,847	73.84	91,150	3,646,000	108,751.76
October ...	123,274	79.68	89,541	3,581,640	123,618.68
November .	114,750	73.50	87,302	3,492,080	121,501.18
December .	127,306	75.42	89,942	3,597,680	131,205.96
1921					
January ..	132,679	73.23	84,435	3,377,400	136,488.61
February .	130,431	81.90	88,135	3,525,400	131,855.43
March	61,288	91.75	52,563	2,102,520	67,086.01
Totals ..	1,683,589	86.90	1,559,269	62,370,760	1711,691.61*
Monthly Average ..	48,102	86.90	44,550	1,782,020	48,905.47

* This cost includes 6 per cent interest on investment and all cost of repairs and rebuilding crashed planes; but does not include depreciation as the Post Office Department is using up discarded and surplus war material.



GLENN L. MARTIN MAIL AIRPLANE, U. S. AIR MAIL SERVICE

CURTISS R-4LM MAIL AIRPLANE, U. S. AIR MAIL SERVICE

PER MILE COST OF AIR MAIL

I. OVERHEAD

Rate of expenditure per year—Actual mileage performance with mail, 1,752,679 miles.

Depreciation at 16-2/3 per cent on buildings, trucks, tools, etc.	22,241.66
Departmental salaries	$49,746.84
Freight and travel expenses	70,716.57
Stationery, printing and incidentals	3,472.00
Radio, telegraph and telephone	29,800.00
Interest at 6 per cent on investment	44,607.00
Total overhead per annum	$220,584.07
Rate of overhead per mile	12.59 cents

II. COST OF FIELD OPERATIONS

From May 15, 1918, to Nov. 30, 1920 (2½ years). Total distance flown with mail, 1,211,785 miles.

Gas	$160,697.79
Grease and oil	28,802.37
Office Force	87,735.61
Motor Cycles, Trucks	57,124.25
Rent, light, fuel, power, telephone & water	24,983.28
Miscellaneous	112,835.50
Pilots	141,562.70
Mechanics and Helpers	212,113.96
Repairs and Accessories	251,664.67
Total	$1,077,520.13
Cost per mile of operations	88.92 cents

III. LOSSES

Planes destroyed by crashes and fires, or so badly damaged as to render them unfit for service, in one million miles of flying with the mails $346,000, or 34.6 cents per mile.

Overhead	12.59 cents
Field operations	88.92 cents
Losses	34.60 cents
Total	$1.36

FORCED LANDINGS

Number of forced landings during period May 15, 1918, to Feb. 28, 1921, during which time 1,602,201* miles were flown with mail.

DUE TO MOTOR TROUBLE	DUE TO WEATHER	TOTAL
734	757	1491

One forced landing due to motor trouble for every 2182 miles flown with mail.

One forced landing due to weather conditions for every 2116 miles flown with mail.

* The total flying exceeds the number of miles flown with mail inasmuch as planes are frequently ferried without mail from one station to another. Test flights are also made.

LENGTH OF ROUTES: NUMBER OF FIELDS, PLANES, PILOTS AND EMPLOYEES

ROUTE	LENGTH MILES	NUMBER FIELDS	NUMBER PLANES	NUMBER PILOTS	NUMBER OTHER EMPLOYES MECHANICS, HELPERS, CLERKS, ETC.
N. Y.-San Francisco	2630	16	50	40	288
N. Y.-Washington	195	3	10	4	41
St. Louis-Chicago	270	3*	7	5	18
Chicago-Twin Cities	360	3*	8	6	26
Warehouse, Newark, N. J...		.	.	.	30
Repair Depot, Bustleton, Pa.		.	.	.	57
	3655	23*	75	55	461

* Chicago Field used by three routes.

DH-4A MAIL AIRPLANE, U S. AIR MAIL SERVICE

SCHEDULES

New York-San Francisco:	(Summer Schedules)	
West:	1st day:	Leave New York, N. Y., 5.30 am, via Cleveland, Ohio, and Chicago, Illinois, to Omaha, Nebraska.
	2nd day:	Leave Omaha, 5.30 am, via Cheyenne, Wyoming, and Salt Lake City, Utah, to Reno, Nevada.
	3rd day:	Leave Reno, 5.30 am, arrive San Francisco, California, 8.00 am.
East:	1st day:	Leave San Francisco, Cal., 5.30 am, via Salt Lake City, Utah, and arrive Cheyenne, Wyoming.
	2nd day:	Leave Cheyenne, 5.30 am, via Omaha, Neb., arrive Chicago, Illinois.
	3rd day:	Leave Chicago, 5.30 am, via Cleveland, Ohio, arrive New York City 3.30 pm.
		(Winter Schedules)
West:	1st day:	Leave New York, N. Y. 7.30 am, via Cleveland, Ohio, arrive Chicago Illinois.
	2nd day:	Leave Chicago 7.30 am, via Omaha, Neb., arrive North Platte, Nebraska.
	3rd day:	Leave North Platte 8.30 am, via Cheyenne, Wyo., arrive Salt Lake City, Utah.
	4th day:	Leave Salt Lake City, 7.00 am, via Reno, Nevada, arrive San Francisco, Cal. 3.30 pm.
East:	1st day:	Leave San Francisco, Cal. 7.00 am, via Reno, Nev., arrive Salt Lake City, Utah.
	2nd day:	Leave Salt Lake City 7.00 am, via Rock Springs, Wyo., arrive Cheyenne, Wyo.
	3rd day:	Leave Cheyenne 7.00 am, via Omaha, Neb., arrive Chicago.
	4th day:	Leave Chicago 7.00 am, via Cleveland, O., arrive New York, N. Y. 5.00 pm.

New York-Washington:	Leave New York City	9.00 am
	Arrive Washington	11.30 am
	Leave Washington	10.40 am
	Arrive New York	1.10 pm
St. Louis-Chicago	Leave St. Louis	10.00 am
	Arrive Chicago	2.30 pm
	Leave Chicago	9.30 am
	Arrive St. Louis	2.00 pm
Chicago-Twin Cities: St. Paul and Minneapolis	Leave Chicago	8.00 am
	Arrive Twin Cities	1.30 pm
	Leave Twin Cities	10.00 am
	Arrive Chicago	3.30 pm

NUMBER OF ENGINES IN SERVICE AND IN RESERVE

NUMBER IN SERVICE	NUMBER IN RESERVE
209	300

FATALITIES, DAMAGE TO MAIL

May 15, 1918, to Feb. 28, 1921

Miles flown (mail, test, ferry) to Dec. 31, 1920	1,612,627
" " " " " " Jan. 31, 1921	139,609
" " " " " " Feb. 28, 1921	143,655
Total	1,895,891
Pounds of mail carried from May 15, 1918, to Feb. 28, 1921	1,506,706

Pilots: One fatal accident for each 105,327 miles flown.
Mechanics: One fatal accident for each 379,178 miles flown.
Percentage of mail damaged: One tenth of one per cent.

NUMBER OF AIRPLANES IN SERVICE AND IN RESERVE

NUMBER IN SERVICE	NUMBER IN RESERVE
75	136

The reserve includes 65 planes at the warehouse allotted by the Army and Navy, but not yet remodeled for service in the Air Mail. These planes are not charged on cost accounts until remodeled for service.

BASIS OF THE STATISTICS

The mileage here given does not include dead flying, such as testing after repairs or ferrying between stations, which amounts to 10 per cent of the whole, but covers only the miles actually flown in carrying out the regular mail schedules. The cost of such dead flying, however, is included under the heads of "Cost of Field Operations" and "Losses".

The total investment of the Air Mail Service is $743,450, being $133,450 for buildings, trucks and tools, and $610,000 for airplanes. The buildings, tools and planes purchased are charged at the prices actually paid for them. The tools and trucks transferred to the Air Mail Service without cost, out of the surplus war stock of the Army, are charged at the price at which they could have been purchased in the market. The airplanes which were transferred by the Army to the Air Mail Service out of the surplus war stock, are charged at their original cost to the Army. Had they been charged at the market price for such surplus war stocks, the value of the equipment would be possibly one- half of the value at which they are carried on the books of the Air Mail Service.

The Army and Navy turned over to the Air Mail Service a great quantity of airplanes and materials that will not be required for the postal service for a long time to come. This was done as an accommodation to the Government and not to meet the immediate or early needs of the Air Mail Service. For this reason, this excess material is not charged with interest or depreciation until it is issued by the warehouse to the service. This excess war material has an uncertain market value, probably not exceeding $100,000, though it cost the Government during the war probably double or treble that sum.

The purpose of the Air Mail statistics is not to make a showing but to furnish dependable data to persons desiring to enter the field of commercial aviation. The data must be safe to make it of value, and for this reason the statistics are reviewed at the end of each year and checked against the audited and outstanding bills for the service. For this reason, likewise, the Air Mail Service has leaned to a liberal rather than a close valuation of its investment.

No arbitrary rate of depreciation is fixed by the Air Mail.

(Continued on page 564)

Curtiss JN-H Mail Airplane, U. S. Air Mail Service. This Machine, Fitted as a Two-Seater, Is Used for Testing Applicants

A Sensation in Co

WHAT HAPPENED!

WHEN THIS FULL PAGE ADVERTISEMENT WAS PUBLISHED IN *THE NEW YORK TIMES* IT CREATED A SENSATION

Pilots, managers of amusement resorts, yacht clubs, resort hotels, pulp and paper companies and aerial sight-seeing and passenger-carrying companies were quick to realize what an opportunity this was to purchase Aeromarine Navy six-passenger flying boats at less than one third of their original cost.

In the Spring, when the supply of these boats is exhausted, the far-sighted men who order now will be able to double their money, for the simple reason that the boats can not be duplicated for less than $20,000. each, and it is already apparent that the supply WILL be exhausted.

One of these boats earned for its owner last season upwards of $1,000. per week.

The possibilities for next season are much greater, because the public now realizes that flying boats are not only absolutely safe, but the most delightful mode of travel.

The Aeromarine Company has invested hundreds of thousands of dollars in successfully operating flying boats for commercial purposes - All of this valuable experience is at the disposal of companies operating Aeromarine flying boats - The supply of boats is limited - Send for booklet and further information to-day -

Navy HS-2-L Flying Boat (Unconverted) F. O. B. Naval Base-Philadelphia, New York, Pensacola and San Diego

***Price . $6,160.00** immediate delivery*

Aeromarine-Navy HS-2-L Six Seat, Open Cockpit Flying Boat, Model 85,

***Price . $6,500.00** immediate delivery*

Aeromarine-Navy HS-2-L Six Seat, Enclosed Cabin Limousine De Luxe

***Price . $9,000.00** immediate delivery*

Aeromarine

FLYING LIMOUSINES
AND FLYING BOATS

Aeromarine Engine

1800 TIMES BUILDING

PHONES BR 45

Aeromarine Sales Service Includes the Securing of Competent and M ment Plan Which Makes It Possible to Pay for These Boats, out of

onercial Aeronautics!

THE NEW YORK TIMES, WEDNESDAY, JANUARY 12, 1921

vernment Takes Big Step to Encourage Aviation

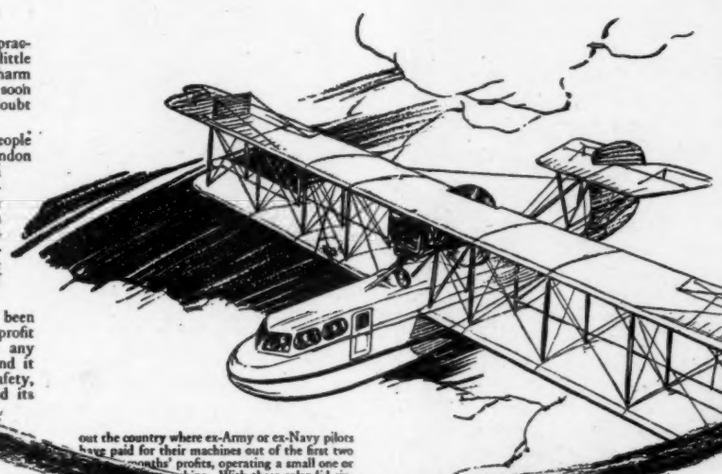
Aes the Sale of the Famous Navy Coast Patrol HS2 Boats Valued at $18,480 Each for $6,160 per Boat

tails of the Plan, of Special Interest to Automotive Men, which Will ace the United States at the Head of the World in Commercial Aviation

always cushioned, always constant, practically unchanging in character, with little friction and no jars and jolts. No charm equals the fascination of flying. As soon as people fly, they realize why all doubt has been removed from aviation.

The hundreds of thousands of people who use the air liners between London and Paris have come to regard them as safer and certainly more comfortable than the channel steamers. The people who are flying daily between Havana and Key West have welcomed air liners as a veritable godsend after the disagreeable experience of a trip over the choppy waters of the Gulf.

In a word, a great business has been ... business greater, from a profit ... than any railroad or any ... of transportation—and it ... to realize its safety, ... economy, and its



out the country where ex-Army or ex-Navy pilots ... paid for their machines out of the first two ...nths' profits, operating a small one or ... With these splendid six-

Before the war Aeromarine was a well-known name in aviation—even then Aeromarine products had proven their worth. It is not strange, therefore, that with our entrance into conflict, the U. S. Navy saw fit to call upon the Aeromarine organization for seaplanes.

The Aeromarine flying boats are the mature issue of this exacting experience. The same careful design, the same expert selection of materials, the same accurate workmanship, and the same rigid, painstaking inspection and final testing which ... for this company the confidence ... Navy will be devoted to the conve... the HS2 boats for use in commerce ... tion. One of the latest achieve... the Aeromarine Company is the ... ment of the "U-8" 160 HP ... Aeromarine motor.

This motor has establishe... for efficiency, fuel economy ... The Aeromarine Plane & ... is the largest exclusive ... boats in the U...

Aeromarine

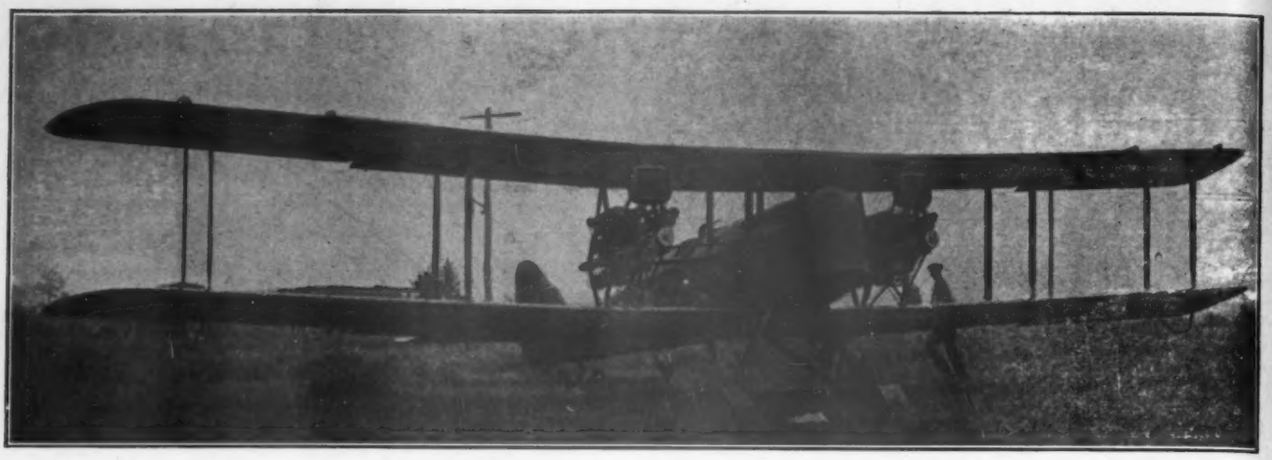
FLYING LIMOUSINES AND FLYING BOATS

eng & Sales Co., Inc.

S BR 4505 or 6147

NEW YORK CITY

eten and Mechanics. We Also Have an Easy Pay-ats, out of Their Earnings. Wire - Write - Phone.



TWIN DH MAIL AIRPLANE, U. S. AIR MAIL SERVICE

Every replacement made necessary by wear and tear or accident, and all labor and overhead connected therewith, is charged to the last penny in the operating account, and all losses are written off at full value under "Losses". Obsolescence is not taken account of, for at the rate of progress in aeronautical engineering all mail planes will be written off as losses before they become obsolete for the work in which they are engaged.

The per mile units of cost in the Air Mail statistics are all based on the substantial scale of one million or more miles of operation. On such a scale they may be depended upon as reliable averages for the type of planes and the character of operation which they represent; that is, flying daily under rough field conditions, with all manner of forced landings and in all kinds of weather.

The total salary of all pilots assigned to a particular route is divided by the total time flown on that route to ascertain the cost per hour. The time shown for each ship is then multiplied by the cost per hour and the result entered under the head "Pilots", against the ship credited with the time flown.

The interest on Investment is arrived at by taking the cost of each type of plane and figuring the interest for a period of one year at the rate of 6 per cent. This is then divided by twelve and the amount entered against each ship of that type appearing on the report.

The Departmental Overhead charge represents the salaries of all supervisory officials and clerks at Washington and is prorated equally among all ships appearing on the reports.

The Advantages of Air Transport

The following table shows the saving in time of air transport over rail transportation.

From	To	1913 h.	1913 m.	1919 h.	1919 m.	Possible by air mail. h.	Possible by air mail. m.
Boston	Detroit	18	10	21	55	8	20
Do.	Chicago	25	50	27	00	8	45
Do.	New York	5	36	6	50	3	00
New York	Chicago	23	50	24	20	9	30*
Do.	Omaha	36	20	38	30	15	20
Do.	Minneapolis	35	42	36	54	13	30
Do.	St. Louis	23	55	28	45	12	05
Do.	Jacksonville	27	35	29	22	11	54
Do.	Seattle	83	15	90	00	31	54
Do.	Portland	84	30	90	30	32	51
Do.	San Francisco	86	40	90	30	35	00†
Washington	Jacksonville	22	00	24	40	8	56
Do.	New Orleans	33	30	36	30	12	51
Do.	Chicago	21	00	22	10	8	11
Do.	St. Louis	23	35	27	55	9	30
Chicago	Minneapolis	10	17	11	24	4	48
Do.	Omaha	11	20	12	45	5	30
St. Louis	Kansas City	7	10	7	25	3	06
Do.	Fort Worth	24	00	26	10	7	25
Do.	Omaha	12	14	13	26	4	42

* The actual flying time between New York and Chicago as maintained by the Air Mail Service is 8 hr. 8 min. on the average.

† The schedule of 35 hr. time between New York and San Francisco implies night flying between Cheyenne and Chicago, a distance of about 800 miles. In the experimental flight made last February to determine the feasibility of a day and night service between New York and San Francisco the total elapsed time between terminals was 33 hr. 20 min., so that the scheduled time was actually bettered. The Air Mail Service intends to inaugurate such a service next summer.

In conclusion it may be said on the basis of practical experience that transportation by airplane is ordinarily twice as fast as by train and on distances of 600 miles or more, no matter how frequent or excellent the train service, airplane mail, even at a higher rate of postage, should equal the cost of its operation. Wherever the train service is not as frequent or as fast as it is between Washington and New York the airplane operations should show real profit on all distances from 500 miles up.

G. Elias & Bro., Inc., Joins Manufacturers Aircraft Association

The Manufacturers Aircraft Association, 501 Fifth Avenue, New York City, announces that the firm of G. Elias & Bro., Inc., of Buffalo, New York, has acquired membership in the organization. This is the twenty-first airplane company to join the association. Of this number sixteen are still active.

The house of G. Elias & Bro. was established as a partnership in 1881 and continued so until 1914, when the business was incorporated with a capital of $500,000 and a surplus of $20,000. In 1919 they established an aircraft department and after two years of preliminary work, began the actual manufacture of airplanes on contracts awarded them by the Army and Navy on their own designs.

In the first Army competition for designs, held on May 24, 1920, they were awarded one of two prizes of $3000.00 for the best designed training plane. On the second Army competition for designs of seven different types, they were awarded a prize of $4500.00 for one of their designs.

In the Navy competitions, in which some forty-five designs were submitted, on Feb. 15, 1921, theirs was one of five designs accepted for final examination.

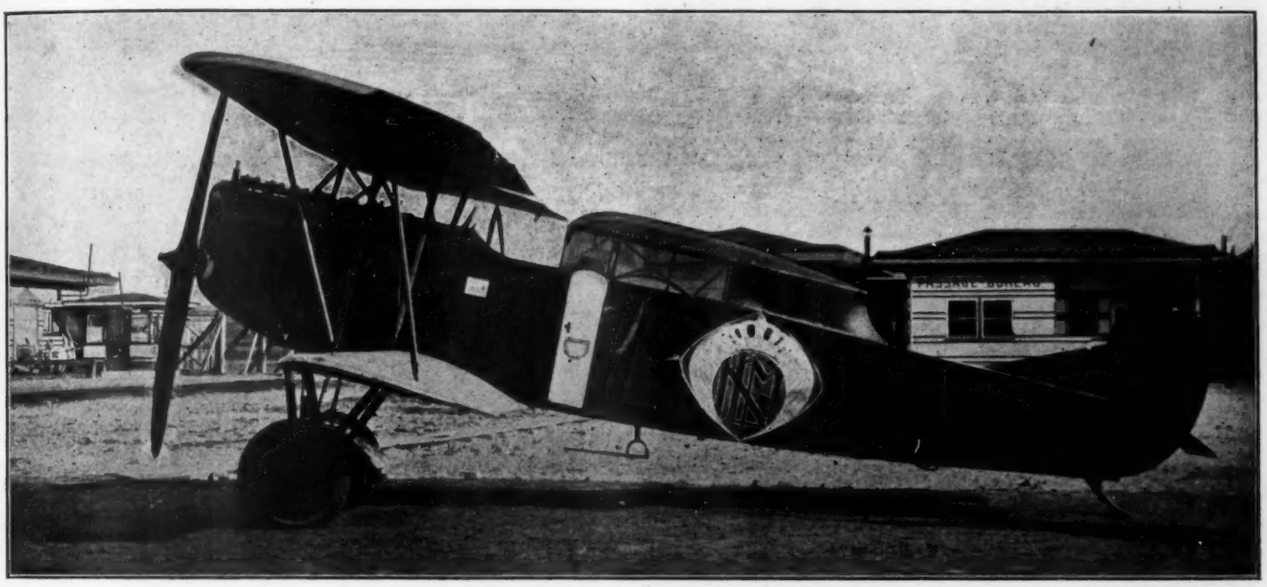
They are now building seven E.M. expeditionary type XIV land and sea planes for the Navy and three training planes for the Army. They have a complete plant and make everything themselves required for the planes that they build. They have a staff of experienced men in every department and are ready to build planes to order for commercial purposes. Their plant at Buffalo occupies twenty acres, on which the factory buildings contain about 300,000 sq. ft. of floor space. They have every facility for economic and rapid production.

The officers of the company are as follows: A. J. Elias, president; A. A. Nessler, vice-president; J. A. Kreuser, treasurer; L. J. Koch, secretary; Max Stupar, superintendent of construction; D. Earl Dunlap, designing engineer; Alexander Klemin, consulting engineer.

The Fokker Commercial Express Type C.II

To anyone studying the needs of commercial aviation and the many uses the world has for airplanes at the present day, it invariably soon becomes apparent that there is a very decided place in the scheme of things for a small and handy 3-seater machine, in fact there is little doubt that its general sphere of usefulness is, at the present stage of aviation, more extended than that of any other type.

Even in the operation of air lines normally using big planes, carrying anything over 1000 lb. paying load, it has been found very advantageous to have some smaller and faster machines, carrying approximately half as much, available for "rush jobs," such as fetching in passengers from places off the main route or taking officials from field to field at any time, as well as for taking the place of the bigger machine on a schedule



FOKKER COMMERCIAL EXPRESS TYPE C.II AIRPLANE

trip, when the paying load is small and time and expense may be saved by using the smaller machines.

For what may be called "irregular air transport", such as aerial taxi and hire work, private and business use, it is in many cases the 3-seater which fills the bill. It is for these purposes that the Fokker C.II is intended and has proved eminently suitable.

A glance at the machine illustrated herewith shows the family likeness to the famous D. VII, which was one of the most redoubtable German pursuit planes of the war. While of slightly bigger dimensions than the D. VII, the C. II shows the same rugged construction, which stands up to the vertical dives for which the D. VII is noted, the same absence of bracing wires and the same simplicity of construction, which make constant attention and skilled riggers unnecessary, the same use of every-day materials throughout the machine, which make for easy repair in the field. The flying qualities of the C. II are equally good, the machine being extremely maneuverable, light on the controls, and remaining completely controllable at the very lowest speeds.

The engine is a 185 hp. B.M.W., a reliable and simple 6-cylinder type which is noted for its low gas consumption (10 gal. p. hr.) and its constant power output at any altitude. This makes it particularly suitable for high flying over mountainous country.

The engine mounting, like the rest of the fuselage, is entirely carried out in steel tube and so arranged that the engine is completely and easily accessible on all sides by removing as much of the quick detachable cowling as is necessary. By this means the labor cost and time involved in making small adjustments, or even removing the engine, is reduced to a minimum. Every detail of this part of the machine being of metal, there is nothing inflammable and nothing which deteriorates through soaking in oil or through heat, anywhere near the engine.

The V fronted radiator makes a nice nose to the machine and fits in well with the cowling.

The propeller is fixed on the boss with one big nut and a cone piece, instead of the usual bolts, so that changing it is a very quick operation and bad alignment through unequal tightening-up is impossible. The diameter of the propeller is 9 ft. 3 in.

One of the striking features of the Fokker C.II is the position of the gasoline tank, which is mounted in the landing gear, just above the axle and the cross member, for which it forms a fairing.

This arrangement protects the occupants of the machine against all danger of fire. Practical tests have conclusively proved that, even if this tank is set on fire during flight, the flames do not touch the rest of the machine and the gasoline burns out, after which a normal descent is made. Thousands of hours of flying under all sorts of conditions, with the Fokker 2-seater fighting planes of the Netherlands Army, have shown up no drawbacks in this placing of the tank and troubles with the gasoline system in general have been remarkably few. The tank is divided into a reserve and main tank containing over 10 and 30 gal. respectively, sufficient for 4 hr. at full throttle and giving a range of 450 miles. The gasoline is forced up to the carburetor by pressure, provided by a pump on the motor, and an auxiliary hand pump. All pipes are carefully secured against vibration and fitted with flexible joints wherever necessary.

The fuselage is constructed on the usual Fokker system, of welded steel tubing. The structure is remarkably strong, very durable and easily repaired in case of damage, by methods obvious to any skilled mechanic.

The landing gear is of the V type. It is particularly strongly made of streamline steel tube and fixed to the fuselage by simple ball and socket joints. The axle is rubber sprung.

The pilot's cockpit is behind the engine compartment and in front of the cabin. The pilot is so placed that he has a very good view both forward and for landing, owing to the reduced chord of the lower wings.

The controls consist of a joy-stick and of a rudder bar; the joy-stick is fitted with a double grip handle of which one side

controls the throttle. There is also a set of throttle controls fixed on the pilot's left at the side of the cockpit, so that either control can be used at the same time. The necessary instruments are fitted on the dash and the hand pump is at a convenient angle, on the pilot's right.

The passenger cabin is behind the pilot, its top forming practically one streamline with the wind screen and the pilot's head. It contains seats for two passengers, arranged staggered, so that both have shoulder room. Entrance is through a good sized door in the left hand side, while the windows are very big and can be left out in hot weather. The cabin being behind the wings, a perfect view of the ground is obtained.

The stabilizer, elevators, and rudder are all entirely of steel tube construction, painted, tape wrapped, linen covered, doped and varnished. The tail plane is triangular in shape; the front cross tube is rigidly fixed across the fuselage and the rear edge is supported by two diagonal stay tubes, running to the bottom end of the stern post. The rudder and fin are braced to the horizontal stabilizer by one wire on each side. The elevators and the rudder are balanced and control cables are duplicated.

The tail skid is of ash, well sprung and high enough to properly protect the rudder.

The wings are of the thick type, and although of biplane form, completely free of external bracing wires, thus permitting very easy and quick erection and dismantling. Setting up the wings is such a quick and simple operation, that it is practically impossible to make mistakes; there is no trueing-up or other delicate adjustment, so that highly skilled riggers are unnecessary. The top wing, which is a one-piece structure and has both a greater span and chord than the lower, has the front spar mounted by two bolts on two tripods of steel tube, projecting rigidly from either side of the fuselage, which completely prevents any movement of the whole wing system, either sideways or fore and aft. The back spar is braced to the fuselage by a ball jointed diagonal strut on either side. The bottom wing, also in one piece, fits into a gap in the bottom of the fuselage and is rigidly fixed by four bolts. The upper and lower wings are joined near the tip by a one-piece N shaped steel strut. The wings are built up with very strong and deep box-section spars of three ply and spruce, solid three ply ribs and a bent three ply leading edge; they are linen covered, doped and varnished. The minimum factor of safety on the structure is 8.

Balanced ailerons are fitted to the top plane only; although of small size they are very effective, and are built of steel tube like the tail surfaces. The control cables run over large diameter pulleys and inspection doors are provided.

PRINCIPAL CHARACTERISTICS OF THE FOKKER C.II 3-SEATER BIPLANE

Span overall	34 ft. 9 in.
Length "	23 ft. 8 in.
Height "	9 ft. 5 in.
Wing area	290 sq. ft.
Weight empty	1820 lb.
Weight loaded	2600 lb.
Maximum speed	115 m.p.h.
Landing speed	45 m.p.h.
Climb	3300 ft. in 5 min.
	10000 ft. in 14 min.
Radius of action	4 hr.; 450 miles
Fuel consumption per hour:	
Gasoline or Benzole	9-10 gal.
Oil	1 gal.

M.A.A. Aircraft Year Book, 1921

The Aircraft Year Book which the Manufacturers Aircraft Association publishes annually has just appeared in its third year of issue. The 1921 issue is the first international edition of the book and contains 424 well illustrated pages. Among the illustrations there are forty-two outline drawings of airplanes and seaplanes which graphically show the development of heavier-than-air craft from the Wright brothers original machine to date. The contents of the book are as follows:—

Chapter I. General introductory chapter, summarizing the year's advance in the art here and abroad, and indicating the trend and the need.

Chapter II. Discussion of aerial transport in the United States and Europe, analysis of operating report of 85 American companies, showing the carriage of 187,000 people for 3,500,000 miles in 1920, without the loss of a single life in direct transportation.

Chapter III. Complete history of the Aerial Mail; mail aircraft fly 8,000 miles daily; lines link United States with Canada and Cuba; time between Atlantic and Pacific Oceans reduced by 24 to 42 hours; many extensions planned.

Chapter IV. Complete history of the United States Aerial Forest Patrol and its extension during 1920; timber cruiser takes to the air; forest observers fight pests as well as fires; aircraft utilized in mine rescue work.

Chapter V. New marine uses for aircraft; seaplanes now "the eyes of the fishing fleet"; sealing operations in the Arctic; U. S. Coast Guard saves life and property at sea.

Chapter VI. Aerial Photography—its uses in surveying, map-making, exploration, city planning, etc.; how aerial maps are made.

Chapter VII. Aircraft the new vehicle for news gathering; how flying has affected the planning and execution of motion pictures.

Chapter VIII. Imperative need for immediate Federal control of the air; action urged by states, leading aeronautical, legal and defense bodies; analysis of International Aerial Convention.

Chapter IX. Air ports, ground organization; aerial communication.

Chapter X. Military and Naval Aeronautics.

Chapter XI. Governmental Policies after the war; aircraft the deciding factor; civilian reserve in trained personnel and production resources necessary to national defense.

Chapter XII. Complete chronology of aeronautical activities throughout the world during 1920.

Chapter XIII. Review of progress in construction of aircraft during 1920.

Chapter XIV. Review of aeronautical activities throughout the world, country by country.

Historical Designs. Forty-two full pages of drawings showing progress of American aircraft design from time the Wrights made the first flight.

In an Appendix there is information on the following subjects:—

Industrial Section. Activity of Manufacturers Aircraft Association in 1920. Individual industrial statements.

U. S. Air Service Section. List of officers on duty in Washington. List of officers on duty in Engineering Section, McCook Field, Dayton, O. List of officers in Engineering School, Dayton. Army Area Air Service officers. The number of officers and men. Location of Air Service units. Air Assistants abroad. Air Service fields, stations, depots, etc.

Naval Aviation. Officers assigned to Naval Aviation on duty Navy Dept. Officers at League Island aircraft factory. Commanders of Air Forces of Atlantic and Pacific Fleet. Graduates of Naval Academy who are also Naval Aviators. List of Naval Air Stations. Number of officers and men. Naval officers performing aviation duties abroad. Data on the Z.R.-2, formerly the R.-38, now building in England, and which the United States Navy expects to fly to the United States in the spring of 1921.

Marine Corps. Marine Corps officers on active duty as qualified Naval Aviators. Aviation stations of Marine Corps. Number of officers and men.

The Aeronautical Board.

The Helium Board.

Aerial Mail Section. Personnel. Performance record. Aircraft in service. Lists of fields. Transcontinental controls.

Miscellaneous Governmental. Forest Fire Patrol Records. Coast Guard. Public Health Service. Sub-Committee on Commercial Aviation, (representing departments of the U. S. Government.) Bureau of Foreign and Domestic Commerce. Bureau of Standards. Forest Products Laboratory. Bureau of Mines (Helium). National Advisory Committee for Aeronautics.

Legislative Section. Complete text of International Aerial Convention. Aerial Law resolution by American Legion. New York State Aerial Law Resolution. Aircraft Insurance. Customs regulations.

Miscellaneous Civil. World Air Records. Aeronautical courses in U. S. Schools and Universities. Aircraft exports 1919 and 1920.

The Ultimate Airplane Engine

By Col. Jesse G. Vincent

Vice-President of Engineering, Packard Motor Car Co.

The development of airplane engines has passed the point where engineers have hopes of miracles. They have come to realize that the airplane engine of the future, whatever its type may be, must be developed by refinements and by improving the details of the methods for producing power that are already in existence. The facts regarding these methods are now so well understood that it is possible to forecast with a reasonable degree of accuracy the course of the development of airplane engines, unless or until some revolutionary discovery overturns the world's entire system for the production of power.

What, then, will the airplane engine of the future be? Will it be some development of the present internal combustion engine, some new type of gas motor, a steam reciprocating engine, a steam turbine, or an electric contrivance? There are possibilities and there would be advantages in each of these forms.

Fundamental Principles of Aircraft Power Plants

In considering this question, let us go back for a moment to fundamental principles. We are governed in the selection of a power plant for an airplane by certain basic rules, the knowledge of which is essential to an intelligent discussion of the problem.

The first axiom is that the power plant must not exceed a certain weight per horsepower, or it will be unable to lift itself and the machine will be unable to fly.

The second axiom is that the engine shall not consume more fuel in the distance that will be required of the plane, than the plane can carry.

There is a further limitation imposed by the practical necessity for a wide range of speed in the plane. It is not safe nor feasible to exceed a certain speed in taking off from the ground or in landing. The landing speed should be very much below the maximum speed of the plane. The difference between the minimum and maximum flying speeds also measures the amount of excess power that is available for climbing and it supplies a factor of safety, so that the machine can continue to fly even if through some defect the power plant is unable to give its full output of power.

This matter of wide range of speed undoubtedly will have a most important bearing on the future development of the airplane. Take for instance the average commercial airplane as developed today. Its landing speed will not be very much under 40 m.p.h. and the maximum flying speed will probably not greatly exceed 100 m.p.h. If it were possible to land this same machine at 20 m.p.h., the utility of the plane would be increased a hundredfold, since special landing fields would no longer be necessary and the danger of damaging the machine in landing would be greatly reduced. Similarly with a landing speed of 40 m.p.h., if the maximum flying speed could be increased to say, 200 m.p.h., the commercial possibilities of such an airplane would be vastly greater.

Of course, the weight of the power plant and fuel supply is by no means the only factor affecting the range of speed. There are several ways of improving the speed range performance of an airplane other than by reducing the weight of the engine and its appurtenances. These include such features as having wings of variable camber or of a variable angle of incidence, having a propeller with a variable pitch and a host of other possibilities which are being thoroughly investigated by engineers today. However, it can be safely stated that no matter what else is done, a saving in weight in a given power plant will always improve the speed range performance of an airplane.

The Vital Question of Weight

Thus so early in considering an airplane, the question of weight of the power plant becomes vital. Furthermore, we must become used to considering the weight of the fuel supply as equal in importance to the weight of the power plant itself. This is because the plane is burdened at the start of its flight with a full supply of fuel as well as with its power plant; it is only when the fuel supply is completely exhausted at the end of a flight that its weight can be ignored.

In long distance flights the initial weight of the fuel is often many times greater than that of the power plant itself. In such cases fuel economy becomes one of the chief considerations and if by increasing the weight of the power plant, within certain limits, we can make the engine more economical in its fuel consumption, such a design would frequently be justified.

Take for example an airplane equipped with a 1,000 hp. engine and designed to carry fuel for a 20-hr. flight. The fuel supply for such a flight with present day engines would weigh approximately 10,000 lb., while the power plant itself would probably weigh only 2,500 lb. Now if we could improve the engine so as to save 10 per cent of the fuel consumption, we could save 1,000 lb. in the initial weight of the fuel to be carried, and the average weight of the fuel on board throughout the trip would be reduced by 500 lb. So we would be justified in adding weight to the engine if by so doing we could improve the fuel economy. But because of the limitations on weight already outlined, this added weight must not exceed 500 lb. This change would be of considerable assistance in the take off, allowing the machine to go into the air at a somewhat lower speed.

Another way of stating the situation is that with a given wing area and a given wing loading, a plane will be capable of carrying a fixed load. This load will consist of the plane itself, including the power plant, the fuel and oil supply and the additional or "useful" load represented by the pilot, passengers and freight, assuming that the plane is engaged in commercial transportation work. Obviously if we are able to reduce the weight of the power plant, we could carry a proportionate additional weight in passengers or baggage.

Wing Loading and Power Loading

In practice at present there are great differences in what is termed the "wing loading" of various types of airplanes, and there are equally great differences in the "power loading" or the unit weight of the plane when expressed in pounds per horse power developed. The expression "wing loading" refers to the relation between the area of the wings used in lifting the plane, and the weight of the complete plane when it is fully loaded. This is generally expressed in the terms of the weight that each square foot of the wing surface will carry, and this figure is reached by figuring the total wing area and dividing this figure into the weight of the plane in pounds. A fair average wing loading may be said to be 7 lb. per sq. ft., but it should be understood that this figure varies greatly with the individual characteristics of the machine, type of wings, and the type of plane—whether it is monoplane, biplane, triplane, etc.

The figure on the power loading is reached by dividing the number of pounds the loaded plane weighs by the number of horsepower developed by the engine or engines. For a rough average, this may be taken as about 14 lb. per hp., although this factor also is subject to extremely wide variations which depend upon the speed of the plane, the head resistance, the propeller efficiency and other considerations.

The unit weights of a typical airplane are represented by the following percentages of the total weight:—

Structural weight of the plane, including the wings, fuselage, landing gear, etc. ..	27 per cent
Power plant, including engine and cooling system	29 per cent
Fuel supply	19 per cent
Useful load	25 per cent
Total	**100 per cent**

It is understood that these figures are not intended to represent an average, since different types of machines vary so greatly. But with some such concrete example as this before us, it will be easier to reach conclusions as to the weight limitations of the power plant.

Let us assume that the complete plane loaded weighs 5,000 lb. According to this table, we can then assume that the power plant will weigh 29 per cent of 5,000 lb. or 1,450 lb. Now, as previously has been stated, the engine should develop one horse power for every 14 lb. of weight and this would give us a requirement of 360 hp. for the 5,000 lb. plane. Since a total weight of 1,450 lb. is available for the power plant, it is possible to have a design which will come to 4 lb. per weight of engine for each horse power developed. It must, however, be understood that in this weight are included all the engine accessories such as the radiator, piping, pumps, water, etc.

Of course this does not mean that 4 lb. of horse power is the absolute maximum limit to the weight of the power plant. We could change the distribution of weight if we wanted to fly a 5,000 lb. plane with no load but the pilot and for very short distances and obtain a table something like this:

Structural weight	27 per cent
Power plant	65 per cent
Useful load	4 per cent
Fuel supply	4 per cent
Total	100 per cent

With this distribution of weight, the power plant would weigh 3,250 lb. and as we have shown that 360 hp. is required this would mean that the power plant could weigh 9 lb. per horsepower. A plane of this design would be able to perform as well as the previous example, but its usefulness would be very much reduced since it would be capable of carrying only one man and fuel for only about an hour's flight. Accordingly, we see that a power plant weighing more than 9 lb. per horsepower is out of the question and that it is very desirable to reduce the weight of the plant to a minimum in order to provide for a high percentage of useful load.

The Question of Fuel Consumption

The next question to consider is that of fuel consumption. The most economical airplane engines today use about .47 lb. of gasoline per horsepower per hour when operating wide open at low altitudes. At high altitudes and with a light load, the specific fuel consumption is likely to be higher. For all practical purposes, we can assume a figure of .5 lb. per horsepower per hour, which means that a 400 hp. engine would consume 200 lb. of gasoline an hour under the conditions given.

We are now ready to consider the possibilities of various types of power plant for airplane use.

At present the internal combustion engine of the four cycle type is practically universally used for airplane service. The weight of the engine alone, that is with the cooling system if it is of the water cooled type, varies from about 1.8 lb. to 3.5 lb. per horsepower according to the arrangement, the number of cylinders, etc.

The Steam Engine

As against these in discussing possible improvements, there must first be considered the reciprocating steam engine. It is probable that a steam engine could be built that would weigh considerably less per horsepower developed than the internal combustion engine does, if airplane engine practices and discoveries were applied to a steam engine design. The chief reason for this is that the four cycle gasoline engine gives only one explosion or impulse in each cylinder for every two revolutions of the crankshaft. So while the mean effective pressure on the piston of the gasoline engine may be as high as 130 lb. per sq. in, there is only one power stroke in four strokes of the piston.

On the other hand, in the steam engine, the lower temperatures at which the work is done makes it possible to use all the strokes for working strokes, so that a double action steam cylinder will give four times as many impulses to the crankshaft as does the conventional four cycle internal combustion cylinder. Then again, the steam pressure can be carried to very high values, well over 400 lb. per sq. in, which would permit of a mean effective pressure on the piston of above 100 lb. per sq. in., allowing for an economical expansion ratio for the steam.

To sum up, it is undoubtedly true that such a steam engine could be built in fairly large units to weigh not more than 1 lb. per horsepower as against the present best practice of 1.8 lb. maximum efficiency per horsepower in the internal combustion engine.

The steam engine itself, however, is only one unit of the steam power plant; there are also the condenser, the boiler, the piping and various accessories to consider. The boiler is the biggest of these items and any present-day design would be practically prohibitive from the point of view of weight. Certain types of flash boilers, such as have been used in steam automobiles, could probably be developed so as not to have excessive weight. It is interesting to note in this connection that Sir Hiram Maxim in 1893 built a steam-driven airplane which was never flown, but the power plant of which was reputed to have developed 363 hp. for a total weight of 1600 lb. giving the rather low figure of 4.4 lb. per horsepower.

However, the whole question of the use of the steam engine is conditioned upon the matter of fuel consumption, and however promising the situation seems to be in regard to the engine itself, the weight of fuel necessary is prohibitive. The largest central station steam power plants which make use of the most efficient power units, today have an overall thermal efficiency not exceeding 15 per cent of the total thermal value of the fuel. In contrast to this, the present-day airplane internal combustion engines of even moderate size are capable of a thermal efficiency above 25 per cent.

Laying all other considerations aside, this represents a handicap which practically bars the steam engine from airplane service. It means that a given weight of fuel, if used under the boiler to generate steam for a steam engine or turbine, will only drive an airplane three-fifths of the distance that the same weight of fuel will drive the plane equipped with an internal combustion engine.

Even this statement does not do justice to the internal combustion engine. Thermal efficiencies of well over 30 per cent have been obtained with airplane engines, while the Diesel engine which has not yet been adopted for aircraft work, gives thermal efficiencies approaching 40 per cent or nearly three times that of the steam engine. It is obvious that no reduction in weight will offset the handicap that the steam engine is laboring under of having to carry two or three times as much fuel as is necessary for a gasoline engine.

This is unfortunate, for it must be admitted that the steam engine offers certain advantages for aircraft work which would be highly desirable. In the first place, it will be generally conceded that the steam engine is less liable to sudden failure than the gasoline engine. This is in general to the fundamental principles involved, although it is safe to say that with sufficient concentration on the details of its design, the gasoline engine will eventually become thoroughly reliable.

In the second place, a steam engine can successfully meet the demands of an overload by simply raising the boiler pressure or increasing the percentage of valve cut-off.

In the third place, the steam engine starts itself and can be easily reversed, which would be useful on an airplane in landing in order to reduce the distance that the plane rolls after the wheels touch the ground.

Finally, the steam engine output for a given boiler pressure is independent of altitude, while a gasoline engine loses half its sea level power when it is taken up 15,000 ft. Of course we do not know how much the decreased ability of the burner at 15,000 ft. would add to the difficulty in keeping up steam, but it is probable that this could be remedied by means far simpler than are required to maintain sea level power at high altitudes with a gasoline engine.

The Steam Turbine

The steam turbine needs little additional comment. As with the reciprocating engine, possibilities of extremely light construction have never been completely explored and there is every reason to believe that the turbine also could be made

considerably lighter than an internal combustion engine of the same power. But with the turbine as with the reciprocating engine, the weight of the boiler and the increased fuel necessary are controlling factors preventing their feasible use for aircraft work. The turbine has the additional draw-back that a reduction gear would have to be supplied to reduce the speed, which might be 20,000 or 30,000 r.p.m., down to the 1,500 or so revolutions demanded by the airplane propeller. The low starting torque and the impossibility of reversing the turbine also make it less attractive for aircraft work than is the reciprocating engine.

Electrical Propulsion

There has been some talk of using electricity in airplanes. In discussing this, it should first be thoroughly understood that in the present state of the development of electricity, the electric motor is not a "prime mover" in the ordinary sense. In other words, electricity has not yet been commercially produced direct from the combustion of fuel. While so-called primary batteries might be used, their operating expense in large units would be prohibitive because of the high cost of zinc, carbon and other materials which are consumed or transformed when the cell is operating.

The only possibility for battery driven airplanes then is in secondary batteries such as the common lead storage battery. The weight of such an installation, so far as we can judge from present day battery performances, would be absolutely prohibitive. A unit weight value of 40 lb. per horsepower hour output would be considered good for present day storage batteries. This must be compared with the gasoline weight of 0.5 lb. per horsepower hour output for the gasoline engine. Even this brief comparison is sufficient to show that an electrically propelled airplane is absolutely out of the question.

There has also been some talk recently of electric-drive airplanes similar in principle to the electric-drive ships which are the latest development in the U. S. Navy. It has been proposed to have one or more internal combustion engines directly connected to electric generators, from which the current would pass to motors driving airplane propellers either direct or through gears.

On the face of it and in the light of the present status of electric engineering, this proposal must be considered highly visionary. As is the case with the steam engine, extreme lightness has never entered as an important consideration in the design if electric motors or generators. It is possible that by using suitable materials and substituting aluminum for copper and by painstaking design, electric units could be built very much lighter than they are now. However, it would be a serious undertaking today to build an electric motor or generator weighing less than 5 lb. per horsepower. This would mean that in addition to the weight of the internal combustion engine, which may be taken at 2.5 lb. per horsepower, we would have a generator weighing 5 lb. per horsepower and an electric motor weighing another 5 lb. per horsepower. This would bring the unit weight of the entire power plant up to 12.5 lb. per horsepower, which we have already seen would be prohibitive, or at least extremely uneconomical for airplane use.

There has also been some talk of changes by which the present four cycle engine could be operated on two cycles, that is, with power applied on every other stroke instead of on every fourth stroke of the piston. This, if it could be done, would of course permit a great reduction in the weight of the internal combustion engine and would materially increase the efficiency of the airplane in respect to its useful load. Extensive experiments have been made along this line and seem to have proved that the plan is not feasible. The temperatures developed in the four cycle engine are already so high that the cooling of such an engine has been one of the most difficult of engineering problems, and there is no method in sight which would permit us to handle the double production of heat that would come in a two-cycle system. So it can be said that at least there is no immediate promise of success with any revolutionary change in the internal combustion engine.

Conclusion

We have now discussed the pros and cons of all conventional types of motor power plants. It has been shown that even today, when both weight of power plant and weight of fuel necessary for any but the shortest of flights are taken into consideration, the internal combustion engine is superior to anything that can be hoped from the other types.

In looking toward the future, it seems clear, after viewing the remarkable strides made by the internal combustion engine in aircraft work during the past decade, that it would be folly to spend much time in speculation as to other sources of power. The weight of the internal combustion engine has been reduced from 4 lb. per horsepower to less than 2 lb.; the fuel consumption has been reduced nearly 50 per cent and reliability has been increased several hundred per cent.

Is it not, therefore, fair to assume that with another decade of development a standard of efficiency will be reached as much beyond our present attainment as our present attainment is beyond the primitive efforts of some ten years ago? With even a small portion of such an improvement, the internal combustion engine will have far outstripped any competitor that now seems to be in sight.

Summing up, I believe that we have not begun to exhaust the possibilities of developing the internal combustion engine for aircraft use. I believe furthermore that development will result from painstaking concentration on the details of design rather than from any startling innovation that could spring up overnight. In any event, we have practically the entire engineering attainment of the past as a precedent to prove that it takes the hardest kind of prodding effort to perfect any mechanism. This work is rarely the result of the genius of any one man or even group of men but ultimately must reflect the best ability of the whole engineering profession.

Cruise of Navy Air Boat Squadron

The Navy Department has received a report from the Naval Air Station, Hampton Roads, telling of the safe arrival there of the Atlantic Fleet Air Boat Squadron and giving a summary of the record cruise just completed. Since last December the squadron, under the command of Commander A. C. Read of Trans-Atlantic flight fame, has covered a total flying distance of about 10,000 miles without a serious mishap.

They left Hampton Roads for the Canal Zone by way of Guantanamo, on Dec. 18, 1920, arriving at Guantanamo on Jan. 13, 1921. The Squadron was at Kingston, Jamaica, on Jan. 15 and left for Old Providence Island on the 17th, and from there for Colon on the 19th, arriving at Colon the same day. The distance from Guantanamo to Colon is 815 miles, and was made in the flying time of 11 hr. and 5 min.

After joining the Pacific Fleet Air Force in maneuvers South of the Canal Zone, the Squadron left Colon for the North on Feb. 19, by way of Great Corn Island, Belize, Isle of Pines, to Guantanamo, arriving at Guantanamo on March 2nd, covering the 1951 miles in 35 hr. and 35 min.

On Apr. 6, after Fleet maneuvers off Guantanamo, the Air Boats left for the North by way of Isle of Pines, Miami, Charleston, and Morehead City. The Squadron was manned by practically the same crew which operated the Air Squadron during the winter of 1919 in the Caribbean Sea, and their intimate knowledge of motors and seaplanes enabled Commander Read to carry out his schedule without delay, and, when crossing the Caribbean, to take the air for a long flight during a storm in which the tender, Sandpiper, was unable to go to sea.

Radio apparatus and compass equipment were tested out during this long voyage and the most gratifying results were obtained in keeping formation and navigating even when visibility was limited by fog and rain.

Air Mail Service in the Philippines

The Philippine Islands are soon to have a postal aerial service, according to recent reports from Manila. Regular lines will be maintained from Manila to Cebu and also from Manila to Zamboanga. Cebu is the premier city of the Visayas and Zamboanga of the southern part of the Philippines.

Five seaplanes have just been received by the Insular Government from the United States. The airplanes will be operated by Filipino aviators trained by the Philippine National Guard.

"Who's Who in American Aeronautics"

(Copyright, 1921, by The Gardner, Moffat Co., Inc.)

Every week, AVIATION AND AIRCRAFT JOURNAL prints the biographical sketch of men who are prominent in American Aeronautics. These sketches will be published later in pamphlet form. As so many of the officers change their stations often, it is believed that a semi-annual issue will be necessary. In compilations of this character many errors and omissions occur. It will be appreciated if corrections are sent to "Who's Who" Editor.

Arthur Raymond Brooks

BROOKS, ARTHUR RAYMOND, Captain, Air Service; born, Framingham, Mass., Nov. 1, 1895; son of Frank Emilien Brooks and Josephine Levassauer Brooks; married, Ruth M. Connery, Sept. 25, 1920.

Educated: Framingham Grammar School and High School, 1900-1913; June 1917, B. S., Mass. Inst. of Tech.

Aeronautical Activities: Trained with U. S. Air Service in Canada, Texas and France, Sept. 1917 to May 1918; Toul Front in May 1918; St. Mihiel and Meuse-Argonne offensives; Flight Commander, Squadron Commander, etc.; flew all types planes in France and U. S.; enlisted Aviation Section, Signal O. R. C., July 23, 1917; flying cadet, School of Mil. Aero. at University of Toronto; flying in Texas (Fort Worth with R. F. C.) and France. (3d A. I. C. Issoudon) R. M. A. test Jan. 26, 1918; 2d. Lt., A. S. Signal R. C., Feb. 25, 1918; 1st Lt., A. S., U. S. A., Nov. 6, 1918; Capt. A. S., U. S. A., Feb. 23, 1919; American Expeditionary Forces, France, March 12, 1918 to July 29, 1919; Toul Sector, May 24, 1918; 139th Aero Squadron, 2nd Pursuit Group; St. Mihiel Offensive, Meuse-Argonne Offensive, 22nd Aero Squadron, 2nd Pursuit Group; Flight Commander; Squadron C. O.; American Ace, officially credited with destruction in combat, of six enemy planes, also several unofficial credits; C. O. 95th Aero Squadron 1st Pursuit Group, Oct. 1, 1919 to May 1, 1920; C. O. 1st Pursuit Group, May 1, 1920 to Feb. 21, 1921; at present Operations Officer 1st Pursuit Group, Kelly Field, Tex.

Flying Rating: Service rating, R. M. A.; at present, Airplane Pilot in Air Service.

War Honors: Distinguished Service Cross; also personal citation 1st Army Air Service Commander, Sept. 6, 1918.

Member: Aero Club of America; American Legion; B. P. O. E.; Archie Club of Boston.

Present Occupation: Operations Officer, 1st Pursuit Group.

Address: 1st Pursuit Group, Kelly Field, San Antonio, Tex.; home, New Kendall Hotel, Farmingham, Mass.

Walter W. Vautsmeier

VAUTSMEIER, WALTER W., Major, Air Service; born, Freeport, Ill., June 21, 1886; son of Conrad F. Vautsmeier and Mary Vautsmeier.

Educated: Freeport High School; University of Illinois; U. S. Military Academy.

Professional: Commisioned 2nd Lt. Coast Artillery Corps, June 15, 1910; 1st Lt., July 1, 1916; Capt., Aviation Section Signal Corps, May 15, 1917; Major (temporary) Signal Corps, Feb. 11, 1918; Major (permanent) Coast Artillery Corps, July 1, 1920; detailed Major, Air Service, July 1, 1920, to date.

Aeronautical Activities: detailed for aeronautical training at North Island, Calif., Jan. 1915; trained until Aug. 19, 1920; served with Air Service since June 12, 1917.

Flying Rating: Reserve Military Aviator Nov. 18, 1918; Airplane Pilot, Jan. 17, 1921.

Member: American Legion; Alamo Post, San Antonio, Tex.; Pensacola Consistory No. 3, Abba Temple, Mobile, Ala.

Present Occupation: Duty, March Field.

Address: March Field, Calif.

George Lewis Bradford

BRADFORD, GEORGE LEWIS, Salesman; born, Winchester, Ky., July 28, 1892; son of Daniel Webster Bradford and Annie Augusta Bradford.

Educated: Winchester Public School; Ph. B. 1911, Bethany College, Bethany, W. Va.

Professional: Salesman, Bloch Bros. Tobacco Co., 1911-1913; Office Supplies (store) 1914-1917.

Aeronautical Activities: U. S. Army Air Service Ground School at Georgia Tech., Sept.-Oct. 1917; Flying School, Nov. to March, Hazelhurst and Gerstner Fields; Dual Instructor, Hazelhurst and Roosevelt Fields 1918 to Aug. 1919; Aerial Mail, Oct. and Nov. 1919.

Flying Rating: Reserve Military Aviator.

Member: Aero Club of America.

Present Occupation: Salesman.

Address: 5950 Avery St., Detroit, Mich.; home, 350 W. Main St., Clarksburg, W. Va.

John Jay Ide

IDE, JOHN JAY, Architect; born, Narragansett Pier, R. I.; son of Rear Admiral George E. Ide, U. S. N. and Alexandra L. (Bruen) Ide.

Educated: Browning School, New York; certificate of Architecture, 1913, Columbia University; Ecole des Beaux Arts, Paris, France 1913-14.

Professional: Architect with H. T. Lindeberg, 2 West 47th St. N. Y, City 1916-17 and 1920-21.

Aeronautical Activities: Aviation correspondent of Scientific American 1911-15 including duty as special Aviation correspondent in France 1913-14. Contributor to "Aviation" and other aeronautical periodicals; In charge Technical Information Section, Bureau of Construction and Repair (Aeronautics), Navy Department, 1917-20; Special aeronautical mission to Europe for Office of Naval Intelligence July-October 1920; appointed Technical Assistant in Europe, National Advisory Committee for Aeronautics, April 1921.

Navy Service: Ensign, Lieutenant (j. g.) and Lieutenant, U. S. Naval Reserve Flying Corps.

Member: Union Club, New York; Army and Navy Club, Chevy Chase Club, Washington, D. C.; Temp. Hon. Member: Royal Automobile Club, Royal Aero Club, Royal Air Force Club, London.

Present Occupation: Technical Assistant in Europe, National Advisory Committee for Aeronautics.

Address: Care Morgan Harjes and Co., Place Vendome, Paris, France.

Spencer Heath

HEATH, SPENCER, Propeller manufacturer; born, Vienna, Fairfax Co., Virginia, Jan. 3, 1876; son of Spencer Anson Heath and Selinda Amelia Heath.

Educated: Washington High School; Corcoran Scientific School of Columbia University; LL.B. 1905, LL.M. 1906, National University.

Professional: Machine designer and engineer, mechanical, electrical, hydraulic and automotive with Elgin Nat'l Watch Co., Western Electric Co., Crane Co., Hartley Motor Co., Purdy & Henderson, Engineers, etc. 1898-1902; engineering work in connection with depots for coal, U. S. Navy Dept., 1902-1906; Attorney at Law, National Union Bldg., Washington, D. C., 1906-1909; experimental and investigation work on aircraft propellers, Washington, D. C. 1909; manufacturer of aircraft propellers, Washington, D. C., 1909-1912; General Manager and Consulting Engineer, Gyro Motor Co., (aeronautical) Washington, D. C., 1911-1912; Pres. American Propeller Mfg. Co., Manufacturers of Paragon Propellers, Baltimore, Md., to date.

Member: Society Automotive Engineers; Aero Club of America; Old Colony Club; City Club of Baltimore.

Present Occupation: President, American Propeller Manufacturing Co.

Address: 233 E. Hamburg St., Baltimore, Md.; home, Elkridge, Maryland.

Benjamin Sturtevant Foss

FOSS, BENJAMIN STURTEVANT, Manufacturer; born, Boston, Mass., Oct. 9; 1886; son of Eugene N. Foss and Lilla (Sturtevant) Foss; married, Dorothy Chapman, Aug. 23, 1911.

Educated: Private Schools, Boston, Mass.; Volkman School; A. B. 1908, A. M. 1909, Harvard University.

Professional: Entered employ of B. F. Sturtevant Co., Hyde Park, Boston, Mass. on Jan. 1, 1910.

Aeronautical Activities: Aided in development of Sturtevant Airplane Motor 1910; Organized Sturtevant Aeroplane Co., 1915; Director Manufacturers Airplane Association from its inception in 1917, to 1919.

War Service: Engaged in industrial work for Sturtevant Aeroplane Co., B. F. Sturtevant Co., and Manufacturers Airplane Association, throughout the war.

Member: Harvard Clubs, New York and Boston; Engineers Club, San Francisco; M. S. A. E.; various social clubs.

Present Occuption: Treasurer, B. F. Sturtevant Co. and Subsidiaries; Director, Hyde Park Trust Co.; Director, Bridgewater Water Co.; Director, Electric Boiler Corp.

Address: Hyde Park, Boston, Mass.; home, Jamaica Plain, Boston, Mass.

Samuel Stillman Pierce

PIERCE, SAMUEL STILLMAN, Lieut. U. S. Navy; born, Wellesley Hills, Mass., Jan. 23, 1887; son of Holden White Pierce and Mary (White) Pierce.

Educated: Volkmann preparatory school (private), Boston, Mass.; Courses in Electricity, Navigation, and Marine Engineering, at Mass. Inst. of Tech.

Professional: Agent for Peerless, Cadillac, and Renault automobiles, Colorado Springs 1907-1908.

Aeronautical Activities: Designed, built and flew two gliders and one power monoplane at Colorado Springs, 1908-1909; worked for Bleriot Aeronautique Co. in France as mechanic, test pilot, instructor and translator of foreign correspondence, 1910-1914; in connection with this work and during this period, was sent to Belgium and Austria for test and demonstration flying, to the Balkans in charge of the Royal Serbian Flying Corps during the first Balkan war (5 months), to Egypt for test flying and operating a small flying school (3 months), to Scotland to organize Lieut. Tryggve Gran's flight across the North Sea; worked for Curtiss Aeroplane and Motor Corp. as test pilot, Hammondsport, N. Y., as flight instructor, Toronto, Canada, and as aircraft inspector, Buffalo, N. Y. (6 months), 1915; President and Chief Engineer, S. S. Pierce Aeroplane Corp., Southhampton, L. I., N. Y., 1916-1917.

Flying Rating: Pilot's license, March 23, 1911, Aero Club of France.

War Service: Commanding Officer Aeronautic Section, 2nd Battalion, Naval Militia, N. Y.; Flight Instructor at Bayshore, N. Y.; Theoretical Instructor at Armory during winter drill periods (1 year); on duty at Naval Air Station, Bayshore, N. Y. (7 months); promoted to Lieut. N. N. V., June 8, 1917; attached to Office of Superintendent Constructor of Aircraft, U. S. N., in New York (2 years); on duty at Naval Aircraft Factory, Philadelphia, Pa. (1½ years).

Member: Aero Club of America; New York Yacht Club.

Present Occupation: Lt. U. S. N. R. F. Ass't, Chief Engineer, Naval Aircraft Factory.

Address: Navy Yard, Philadelphia, Pa.; home, 53 West 54th Street, New York.

Carlyle Hilton Wash

WASH, CARLYLE HILTON, Major, Air Service; born, Minneapolis, Minn., Oct. 15, 1889; son of James A. Wash and Mrs. James A. Wash; married, Constance Rogers, May 14, 1919.

Educated: University of Minnesota; U. S. Military Academy.

Professional: 2nd Lieut., 1st Lieut., and Capt., 6th U. S. Cavalry; border service, Pershing's Mexican Campaign, 1916.

Aeronautical Activities: Started flying Sept. 1, 1917, Rockwell Field, San Diego, Calif., continuous flying duty to date; have flown thirty-five different types of airplanes; Chief of Experimental Flying Section; Engineering Division Air Service.

Flying Rating: Junior Military Aviator, Dec. 13, 1917.

War Service: Commanding Souther Field, Americus, Ga., throughout war.

Member: Aero Club of America.

Present Occupation: Chief of Experimental Flying, McCook Field.

Address: McCook Field; home, 823 Far Hills Ave., Dayton, Ohio.

Emile Berliner

BERLINER, EMILE, Inventor; born, Hannover, Germany, May 20, 1851; son of Samuel Berliner and Sally (Friedman) Berliner; married Cora Adler, Oct. 26, 1881.

Educated: Hannover public and high schools.

Professional: Invented, loose-contact telephone transmitter 1877; disc talking machine 1887.

Aeronautical Activities: Made helicopter experiments; first to use rotary motor for aeronautical purposes, 1908.

Member: Aero Club of America; Aeronautical Society of America.

Present Occupation: Pres. of Washington (D. C.) Society for Prevention of Tuberculosis.

Address: 1458 Columbia Road, Washington, D. C.

Thomas Scott Baldwin

BALDWIN, THOMAS SCOTT, Aeronaut; born, Berrien County, Mo., June 30, 1854; son of Samuel Yates Baldwin and Jane Baldwin; married, Cary Poole, 1878.

Educated: Country School 1862-1870.

Aeronautical Activities: 46 years flying experience, 1875 to 1921.

Flying Rating: Dirigible Balloon Pilots License No. 1; Aviator License No. 7 and Spherical Balloon License No. 9, Aero Club of America.

War Service: Commissioned as Captain in Air Service, April 25, 1917, active duty Aug. 31, 1917; Commissioned Major, June 18, 1918; during war was Chief, Army Balloon Inspection and Production; discharged Oct. 1919.

Member: Aero Club of America; Elks, No. 1 N. Y.; Odd Fellows; K. of P.; all branches of Masonic Order up to 32nd degree.

Present Occupation: District Mgr., Balloon Production and Inspection, Goodyear Tire and Rubber Co.

Address: Care of Goodyear Tire & Rubber Co. Akron, O.

Henry A. Berliner

BERLINER, HENRY A., Engineer; born, Washington, D. C., Dec. 18, 1895; son of Emile Berliner and Cora (Adler) Berliner.

Educated: Public Schools, Washington, D. C.; McKinley Manual Training School, Washington, D. C.; Cornell, 1914-1916; 1918, B. S. in Mechanical Engineering, Mass. Inst. of Tech.

Aeronautical Activities: Designed, constructed, and flew helicopter, 1919; engaged at present in helicopter development.

War Service: Air Service, U. S. Army, 1918-1919, Aerial Photography.

Present Occupation: Experimental Aeronautics.

Address: 1458 Columbia Road, Washington, D. C.

Robert H. Cannon

CANNON, ROBERT H., Engineer; born, New Brunswick, Canada, April 30, 1891; son of Fletcher B. Cannon and Dorcas A. Cannon.

Educated: Public Schools, Rutland, Mass.; A. B. 1914, Clark University.

Professional: Dennison Mfg. Co., 1914-1916 (Farmingham, Mass.); Norton Co., 1916 (Worcester).

Aeronautical Activities: Kelly Field Aug.-Nov. 1917; Berkeley Ground School, Nov. 1917-Feb. 1918; Camp Dick; Call Field, April-Sept. 1918; Ellington Field, Sept. 1918-Jan. 1919.

Flying Rating: 2nd Lieut., Reserve Military Aviator, Call Field, Aug. 6, 1918; 1st Lieut., Reserve Military Aviator.

Present Occupation: Engineer, Norton Co.

Address: Norton Co.; home, New Bond St., Worcester, Mass.

Reed Gresham Landis

LANDIS, REED GRESHAM, Executive; born, Ottawa, Ill., July 17, 1896; son of Kenesaw M. Landis and Winifred (Reed) Landis.

Educated: public schools of Chicago; University of Chicago.

Professional: Advertising and sales, since 1915.

Aeronautical Activities: U. S. Air Service, June 1917 to March 1919; Vice-President Interallied Aircraft Corp., July 1919 to Jan. 1920.

Flying Rating: Military Aviator.

War Service: Attached to British R. A. F. 40 Squadron until Sept. 1918; Major, Air Service Commanded U. S. 25th Aero Squadron, Sept. 1918 to Jan. 1919; Granted British Distinguished Flying Cross; American Ace, Officially credited with destruction of 9 airplanes and 1 Balloon.

Books: "On the Roof of the War"; "The Business Future of Aviation."

Member: Hamilton Club of Chicago; various Aero Clubs throughout the country.

Present Occupation: Vice-President, Keith-Landis Corp.

Address: Postal Telegraph Bldg., Chicago, Ill.

Edwin Rickards Michie

MICHIE, EDWIN RICKARDS, Executive; born, Calcutta, E. India; son of John Shaplan Michie and Kathrine (Rickards) Michie; married, Gertrude M. Sylvester Jan. 16, 1904.

Educated: Private Schools; E. M., S. M. Dulwich, Cambridge University, England.

Professional: General Manager, Northern Pyrites Co.; Vice Pres., Sylvester Manufacturing Co. (implements and motors); Vice President, Ordnance Engineering Corp.

Aeronautical Activities: Manufacturing airplanes for U. S. Government and civilians.

Member: Patterson Golf Club; New York Athletic Club; S. A. E., Aero Club of America.

Present Occupation: Vice President, Ordnance Engineering Corp.

Address: 120 Broadway, N. Y.; home, 440 Pelham Manor Road, Pelham, N. Y.

James Armand Meissner

MEISSNER, JAMES ARMAND, Steel Business; born, Londonderry, N. S. Canada, July 30, 1896; son of Carl August Meissner and Clara (Ayer) Meissner.

Educated: Public school 139, Brooklyn, N. Y.; Erasmus Hall High School, Brooklyn, N. Y.; M. E. 1919, Cornell University.

Professional: Started work for Tennessee Coal, Iron and R. R. Co., Ensley Plant, Ala., Oct. 1919; still with same Co., learning steel plant operation.

Aeronautical Activities: Enlisted Cornell S. M. A., May 28, 1917; sailed for France, July 23; started flying training at Tours, France, Aug. 16; through Avord, Issoudun, Cazeau; to 94th Squadron, March 8, 1918 at Toul; Through Chateau-Thierry, St. Mihiel, Argonne, Drives; C. O. 147th Squadron, July 23, 1918; American Ace, Officially credited with destruction of 7 airplanes and 1 Balloon; Commissioned, 1st Lt., Dec. 12, 1917; Capt., Oct. 3, 1918; Major, Oct. 4, 1918.

Flying Rating: Reserve Military Aviator Dec. 12, 1917; Junior Military Aviator, Oct. 4, 1918.

War Honors: May 15, 1918, Croix de Guerre with Palm; another Palm, July; D. S. C. with Oak Leaf, Oct. 19, 1918.

Member: Aero Club of America; Birmingham Flying Club; Sons of American Revolution; Sigma Phi Epsilon Fraternity.

Present Occupation: Steel business, Birmingham, Ala.

Address: Central Y. M. C. A., Birmingham, Ala.

Hiram Percy Maxim

MAXIM, HIRAM PERCY, Inventor; born, Brooklyn, N. Y., Sept. 2, 1869; son of Sir Hiram Stevens Maxim and Jane (Budden) Maxim; married, Josephine Hamilton, Dec. 21, 1898.

Educated: Public Schools, Brooklyn, N. Y.; 1886 Mass. Inst. of Technology.

Professional: Electrical and Mechanical engineering, Thomson Electric Welding Co., Westinghouse Electric and Mfg. Co., Electric Vehicle Co., Maxim Silencer Co., American Chain Co., etc.

Aeronautical Activities: 1911, flying experiments with gliders; several good flights but injured and had to stop; President, City of Hartford Municipal Aviation Commission.

Member: President, Aero Club of Hartford since 1911; Engineers, (N. Y.).

Present Occupation: President Maxim Silencer Co.

Address: 83 Homestead Ave., Hartford, Conn.; home, 276 No. Whitney St., Hartford, Conn.

William Caldwell McChord

McCHORD, WILLIAM CALDWELL, Major, Air Service; born, Lebanon, Ky., Dec. 29, 1881; son of R. C. McChord and Elizabeth H. McChord.

Educated: Public schools, Lebanon, Ky.; B. L. 1901, Central University, Ky.; U. S. Military Academy, 1907.

Aeronautical Activities: Executive Officer, Ellington Field, July 1 to Aug. 14, 1918; Commanding Park Field, Aug. 16 to Nov. 12, 1918; Commanding Gerstner Field, Dec. 16, 1918 to March 3, 1919; Assistant Chief, Finance Division, Air Service, March 15 to July 30, 1919; Chief, Material Disposal and Salvage Division, Air Service, July 31 to Sept. 15, 1919; Ass't. Chief of Property Division, Air Service, Sept. 16, 1919 to June 1920; Air Service Officer, Central Dept. Chicago, July 1920 to Oct. 1920; Air Officer, 6th Corps Area, Fort Sheridan, Ill., from Oct. 1920 to date.

Flying Rating: Junior Military Aviator, May 30, 1918.

War Service: Served throughout the war, Regular Army.

Member: Army and Navy Club (Wash.); Chicago Athletic Club; Hon. Member, Aviation Club of Chicago.

Present Occupation: Air Officer, 6th Corps Area.

Address: Fort Sheridan, Ill.

Robert J. Hawley

HAWLEY, ROBERT J., Aviator; born, Northumberland, Pa., May 31, 1901; son of C. B. Hawley and Emma W. (Myers) Hawley.

Educated: Sunbury High School; Northumberland High School; S. A. T. C., 1918, Susquehanna University; Pennsylvania State College, Forestry, 1920.

Aeronautical Activities: Entered Essington School of Aviation, Aug. 3, 1919; graduated as operator of seaplanes and flying boats, Oct. 9 of same year; returned to Essington as reserve pilot, April 15, 1920 and left May 15 to take exam. for Army Air Service but was rejected, too young.

Flying Rating: Diploma of Essington School of Aviation, Oct. 9, 1919.

War Service: S. A. T. C. at Susquehanna, 1918.

Member: Aviators' Club of Pennsylvania, Philadelphia, Pa.

Address: 394 Queen Street, Northumberland, Pa.

Edson Fessenden Gallaudet

GALLAUDET, EDSON FESSENDEN, Aeronautical Engineer; born, Washington, D. C., April 21, 1871; son of Edward Miner Gallaudet and Susan (Denison) Gallaudet; married, Marion Cockrell, Feb. 14, 1903.

Educated: Hartford public High School; Bach. Arts, 1893, Yale University; 1896, Ph. D. John Hopkins University.

Professional: Westinghouse Electric Co., 1896-1897; Instructor in Physics, Yale University 1897-1900; Cramps Shipbuilding Co., Philadelphia, 1900-1903; Platt Iron Works Co., Dayton, O., 1903-1908.

Aeronautical Activities: Started Gallaudet Aircraft Co. in 1910; Secured American Pilot's license with Wright Biplane, July 1911; Secured French pilot's license with Nieuport Monoplane, Nov. 1911.

Member: Engineers Club; Aero Club of America; Agawam Hunt Club, Providence.

Present Occupation: Chairman of Board and Chief Engineer, Gallaudet Aircraft Co.

Address: Gallaudet Aircraft Co., East Greenwich, R. I.; home, 152 George St., Providence, R. I.

Sidney Dunn Waldon

WALDON, SIDNEY DUNN, Engineer; born, London, England, Jan. 29, 1873; son of James Ley Waldon and Julia (Dunn) Waldon; married, Lois Strong Burton, Oct. 20, 1898.

Educated: London Public School; South Kensington Science and Arts.

Professional: Hobbs-Hart & Co., London; trade as locksmith; Cooper Engine Co. and Mount Vernon Bridge Co., Mount Vernon, Ohio, 1893 to 1895; Ball Eng. Co., Erie, Pa., 1896-1900; Foster Auto Co. Rochester, 1900-1902; Packard Motor Car Co., 1902-1915; Cadillac Motor Car Co., 1915-1916.

Aeronautical Activities: Charter member, Aero Club of Michigan and President during later years; helped buy plane and train Michigan National Guardsmen at Grayling, Mich., during 1916; flew as passenger first time in Wright plane, 1910, also started ballooning same year.

War Service: Army, enlisted Dec. 1916; Capt. Aviation Section Signal Corps, Feb. 19, 1917; member first Aircraft Production Board; Col. Air Service, Aug. 26, 1917; Overseas, Oct. 1917 to Feb. 1918; discharged Dec. 12, 1919.

Member: Aviation Country Club; member, advisory board for aviation, Detroit; Chairman, Aeronautical Com. Board of Commerce; Chairman, Committee organizing Pulitzer and other trophy races in Detroit, Sept. 8-9-10, 1921.

Present Occupation: Engineering.

Address: 4612 Woodward Ave., Detroit, Mich.; home, 160 Longfellow Ave., Detroit, Mich.

James Comly McCoy

McCOY, JAMES COMLY, Aeronaut; born, Urbana, Ill., Feb. 5, 1862; son of Asa S. McCoy and Lydia (Chamberlain) McCoy; married Florence Littlefield, June 1, 1892.

Educated: Bloomington, Ill., High School; Wesleyan University, Jacksonville, Ill.

Professional: Electrolytic Copper Refining, 1893 to 1906; Banker, President Perth Amboy Trust Co., 1906 to 1916.

Aeronautical Activities: Balloon pilot since 1906. Aide to Capt. C. DeF. Chandler in winning first Lahm Trophy 1907 (20 hrs. 15 min.); Pilot Aeronautique.

Flying Rating: Aero Club of France, 1906; Aeronautic Pilot, Aero Club of America, License No 1, 1907; Junior Military Aeronaut.

War Service: Capt., Signal Corps; Major, U. S. Air Service.

Member: Aero Club of America, (incorporator); N. Y. Yacht Club; Manhattan Club; Grolier; Hope Club; Squanturn Club, Providence, R. I.; Travellers Club of Paris, France.

Present Occupation: Retired.

Address: Nayatt Point, West Barrington, R. I.

Donald Wills Douglas

DOUGLAS, DONALD WILLS, Aeronautical Engineer; born, New York City, 1892; son of Wm. E. Douglas and Dorothy (Locker) Douglas; married, Charlotte Ogg, 1916.

Educated: New York City schools; U. S. Naval Academy; S. B. 1914, Mass. Inst. of Tech.

Professional: Ass't in Aerodynamics M. I. T., 1914-1915; Chief Engineer, Glenn L. Martin Co., Los Angeles, Calif., 1915-1916; Chief Civilian Aeronautical Engineer, Signal Corps, 1916-1917; Chief Engineer, Glenn L. Martin Co. of Cleveland, 1917-1920; Vice President and General Manager, Davis-Douglas Co. of Los Angeles, Calif., 1920 to present time.

Aeronautical Activities: Aeronautical designer.

Member: Society Automotive Engineers.

Present Occupation: Davis-Douglas Co., airplane construction.

Address: 421 Colyton St.; home, 1148 Tenth St., Santa Monica, Calif.

From Miami to Washington

With six prominent passengers and a crew of four, the flying boat "Santa Maria", of the Aeromarine West Indies Airways, alighted on the Potomac River at Washington, Apr. 13, after a highly successful flight which began on the morning of Apr. 11 at Miami, Fla. The passengers were all prominent men of Detroit, five of them automobile manufacturers, and the other Dr. Inches, Commissioner of Police and Acting Mayor. Among the manufacturers was W. E. Metzger, President of the D.A.C. The party had previously chartered the "Santa Maria" for a flight from Miami to the island of Nassau and return. The enthusiasm of the members of the party as the result of this first experience in air transportation prompted them to charter the "Santa Maria" as a speedy and enjoyable means of going north.

No attempt was made to establish any record and the trip was made with the idea of comfort and enjoyment for the passengers. Several stops were therefore made and the passengers spent the two nights at hotels en route. The flying time was approximately 17 hours.

The possibilities of commercial flying boat service are almost daily being demonstrated by the F-5-L and HSL-2 seaplanes which were turned over by the Navy to the Aeromarine Co. for distribution in order to encourage commercial flying. A daily New York to Albany service, with a boat leaving in each direction daily will be inaugurated about May 1. On Friday, April 15, an Aeromarine-Navy HSL-2 left New York for Hartford, with Judge Wm. J. Malone, Chairman, Aviation Committee of the Connecticut Chamber of Commerce, and Hiram P. Maxim, President, Hartford Aviation Commission, for the purpose of demonstrating to Hartford and other Connecticut River cities the practicability of a regular New York-Hartford and Connecticut River points service.

The machine carried a letter from Mayor John F. Hylan to the Mayor of Hartford, which is reproduced herewith:—

Dear Mr. Mayor:—

I take pleasure in handing you herewith, on behalf of the City of New York, felicitations on the pathfinding trip of the flying boat "Aeromarine" between our city and the City of Hartford. While our municipalities have been drawn closely together by rail and motor, we are now entering an age of faster communication. The flying machine reduces the journey to a minimum. This system of aerial communication, I am convinced, proves the wisdom of the United States Navy in alloting for commercial service a limited number of Navy Coast Patrol Flying Boats. It is apparent to all patriotic citizens that we cannot hope to have aviation for national defense until civil and commercial aviation is established in this country to the same extent as abroad. The successful conversion of these boats for commercial purposes, and the policy of the Navy Department in permitting the public to purchase them at a fraction of their original cost, goes far toward eliminating the handicap that has heretofore retarded public interest in flying. It is our hope that some means will be found to ensure steady and continuous aerial transport between the City of New York and the City of Hartford.

JOHN F. HYLAN,
Mayor.

Naval Airships for Commercial Uses

Immediately following the arrival in this country in July of the rigid airship ZR-2 now nearing completion in England, the Navy will begin experiments to determine the feasibility of the use of rigid airships for commercial purposes. Plans now under consideration in the Department include long distance flights by the ZR-2 that will cover practically every section of the country.

Mooring masts, which have now proved to be a satisfactory method of mooring-out large airships, will be erected at Chicago and other points West, to accommodate the ZR-2 at intermediate stops between the Atlantic and Pacific coast. Arrangements are now being completed for the ZR-2 to make a trip, shortly after her trans-Atlantic flight, to Chicago, carrying a message which President Harding will be asked to send to the officers of the Chicago Exposition, which will be held during July and August, 1921. Other points between Chicago and the Pacific Coast where masts will be needed will be Omaha and Salt Lake City and possibly others.

It is believed by the Navy Department that the great stretches of territory embraced in this country make airships particularly adaptable as commercial carriers. To definitely establish this, numerous flights across the country will be made by the ZR-2 as long as they do not interfere with the Naval activities of the ship.

WHERE TO FLY
Passenger Carrying, Pilots' Training, Special Flights

CALIFORNIA
CALIFORNIA'S MOST COMPLETE SERVICE
MERCURY AVIATION COMPANY
HOLLYWOOD, CAL.

CALIFORNIA
SAN FRANCISCO, CALIFORNIA
EARP P. COOPER AIRPLANE & MOTOR CO.

CALIFORNIA
LARGEST FLYING FIELD IN WEST
REDWOOD CITY, CALIFORNIA
WALTER T. VARNEY 832 POST ST. SAN FRANCISCO, CAL.

INDIANA
One of the largest and best equipped flying fields in the United States.
CURTISS-INDIANA COMPANY
Kokomo, Indiana
ALL TYPES OF CURTISS PLANES.

LOUISIANA
GULF STATES AIRCRAFT COMPANY
SHREVEPORT, LA.

MASSACHUSETTS
BOSTON AND SPRINGFIELD, MASS.
EASTERN AIRCRAFT CORP.
340 FIRST ST., BOSTON, MASS.

MINNESOTA
MINNEAPOLIS, MINN.
SECURITY AIRCRAFT CO.
FIELD, HANGARS, SHOPS

NEW JERSEY
DEAL AND SPRING LAKE, NEW JERSEY
HANGARS, SHOPS, FIELDS
DE LUXE AIRCRAFT SERVICE, INC.

NEW YORK
5-PASSENGER FLYING BOATS
NEW YORK AERO LIMITED FLORIDA
GOTHAM BANK BLDG., NEW YORK, N. Y.

NEW YORK
CURTISS AIRDROME
HAZELHURST FIELD, MINEOLA, LONG ISLAND
CURTISS AEROPLANE & MOTOR CORPORATION

OHIO
DAYTON, OHIO.
Supplies, Hangars, Shops and Field 1 Mile from Dayton limits.
JOHNSON AIRPLANE & SUPPLY CO.

PENNSYLVANIA
Flying School and Commercial Aviation
Send for Circular
Official Flying field Aero Club of Pennsylvania
PHILADELPHIA AERO-SERVICE CORPORATION
636 Real Estate Trust Building, Philadelphia.

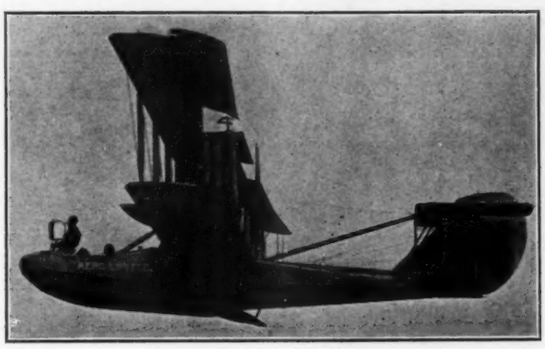
TRAVEL BY AIR

WITH

AERO LIMITED INC.

ANYWHERE THERE'S AIR AND WATER

No Stunts or Acrobatic Flying



Seaplane Service to All Points

AERO LIMITED—The Oldest Commercial Air Travellers in America—Has Carried 14,000 Certified Passengers to Date

COMFORTABLE SERVICE DAY OR NIGHT

In any of the flying boats comprised in the Aero Limited Fleet you ride in a comfortable seat equally as well appointed as your private car. The seating arrangements in the plane enable you to have a clear view of the earth beneath you at all times.

Over New York - A real sight seeing tour of America's greatest city
New York to Atlantic City Air Service
New York - Newport - Boston - Air Service
New York - Albany Air Line Lake George - Lake Champlaine

The Aero Limited Fleet is manned by officers and crew with a record of long and faithful service. After thorough tests by U. S, Government experts they have been passed by authorities as men of proven worth and ability to fly seaplanes for passenger service.

AERO LIMITED INC.

First aerial passenger routes in America

EXECUTIVE OFFICES GOTHAM BANK BLDG. N. Y.

FOREIGN OFFICES

Havana, Cuba
Nassau, Bahama Islands
Bimini, B. I.
Isle of Pines

Travel by "Air"

DOMESTIC OFFICES

New York
Palm Beach, Boston
Lake George
Miami, Fla., New Port

AIRCRAFT YEAR BOOK

1921

Aeronautics—The most talked of element to-day in Commerce and national defence

NTERNATIONAL Edition of the Aircraft Year Book just off the press—360 pages—275 text and reference data, 38 illustrations, 47 historical aircraft designs, maps, etc.

This book tells you what you should know concerning flying in all its phases, transport of passengers and packages, mail, forest patrol, fishery work, photography, world records, law, airports—military and naval developments.

The edition is limited. Sign and return the attached blank to-day. Published by

MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

Fill in and return order blank with remittance.

The GARDNER, MOFFAT CO.
225 Fourth Ave., New York.

Gentlemen:

I enclose check (or) money order (please indicate which) for.....for which please send me postpaid .....copies of the 1921 Aircraft Year Book at $3.20 each, postpaid.

(please print) *Name*.....

E *Address*.....

THE FLYING **T** IS OUT!!

or soon will be on every Field in the country, yours included.

Do you know our EMPLOYMENT COMMITTEE will furnish particulars and place you in touch with ex-service Pilots, Master electricians, Aero-Mechanics, Riggers and Field Men, Radiomen too, upon application.

Of course this service is Gratis.

Address your applications NOW to

AIR SERVICE POST

AMERICAN LEGION

11 East 38th Street New York

The President Has Announced

A POLICY OF ENCOURAGEMENT OF MILITARY AND CIVIL AVIATION

There is now every reason to anticipate immediate progress in building up the Army, Navy, Postal and other Government air services. Large orders have already been placed. Civil aviation also will be fostered by national legislation and the development of landing fields and airdromes will have Government encouragement.

IT WILL PAY YOU TO KEEP CLOSELY IN TOUCH WITH THESE DEVELOPMENTS AND COMPLETE TECHNICAL DETAILS BY READING EACH WEEK THE RECOGNIZED AMERICAN AUTHORITY ON AERONAUTICS—

AVIATION AND AIRCRAFT JOURNAL.

Special Offer Six Months -- 26 issues -- Two Dollars

THE GARDNER, MOFFAT COMPANY,

225 Fourth Avenue, New York

West Bay of the Woodworking Shop

Wittemann Aircraft Corporation

TETERBORO, HASBROUCK HEIGHTS, NEW JERSEY

CULVER SUMMER AVIATION SCHOOL

(On Lake Maxinkuckee)

A conservative and thorough course. Conducted with all the thoroughness and scrupulous attention to details that have characterized all Culver undertakings. Under conservative and experienced instructors who exercise every precaution for safety and with splendid equipment maintained at the highest degree of efficiency by skilled mechanics, this course has won the confidence of parents and opened up the great new field of flying to the boys of America. Catalogue on request, also of Naval, Cavalry, Artillery and Woodcraft Schools. Address

CHIEF EXECUTIVE'S AIDE

Culver Ind.

SCHNEIDER ALTIMETER

THE IMPORTANCE of an accurate and reliable Altimeter is universally appreciated.

The Schneider Altimeter is not only an accurate instrument, but is built to withstand the hardest aircraft service. Owing to its rigid construction it is unaffected by vibration and will maintain its accuracy for an exceptionally long period.

An important feature, assuring reliability, is the chain. This is of non-corrosive material and of special design. In smoothness of motion it surpasses any other type of chain, and its use avoids the inaccuracies of altimeters using the old steel chain, which rusts and jambs when exposed to dampness.

Schneider Bros., the manufacturers of the Schneider Altimeter, have been engaged for over thirty years in the manufacture of the highest grade of meteorological instruments. Their extensive experience enables them to produce an aviation altimeter of unusually fine quality. Schneider Altimeters have been supplied in large quantities to the U. S. Army and Navy.

The Schneider Altimeter is now sold exclusively by the Pioneer Instrument Company, the leading manufacturers and distributors of aircraft instruments in the United States.

PIONEER INSTRUMENT COMPANY
136 Havemeyer Street Brooklyn N Y

THE AIRCRAFT SERVICE DIRECTORY

Where to Procure Equipment and Services

AIRPLANES	ACCESSORIES	EXHIBITION WORK	PARCEL CARRYING
ENGINES	TRAINING FOR	AERIAL ADVERTISING	AERIAL PHOTOGRAPHY
PARTS	PILOT OR MECHANIC	PASSENGER CARRYING	AND MAPPING

FOR SALE
CURTISS MODEL F FLYING BOAT
NEW—IN PERFECT CONDITION
Have two, will sell one cheap
FRANK G. SCHENUIT
1200 Mt Royal Ave., Baltimore, Md.

Aerial Cameras and Accessories
Aerial Photographs
FAIRCHILD AERIAL CAMERA CORP.
136-146 West 52nd St., New York.

REDUCTIONS
IN NEW CANUCK & OX-5 ENGINE SPARE PARTS.
New Rome Turney Rads, $23—C.A.L. & Paragon Props. $20. etc.
Also a complete assortment of
3½ per cent. nickel steel bolts, screws, clevis pins, eyebolts, nuts, ferrules, thimbles, turnbuckles, wire and cable.
Write for our 1921 price list.
AIRCRAFT MATERIALS AND EQUIPMENT CORP.
1407-9 SEDGWICK AVE., NEW YORK CITY.

HAMILTON PROPELLERS
DELIVER THE GOODS
HAMILTON AERO MFG. CO.
679 LAYTON BLVD. MILWAUKEE, WIS.

PRICE REDUCTION
—on—
New and Rebuilt JN4D, Canuck, F Boat, OX & K-6 Motors, Parts
Immediate delivery
CURTISS EASTERN AIRPLANE CORP.
130 So. Fifteenth St., Philadelphia, Pa.

L. P. WITHERUP
Mechanical Designing Engineer
DESIGNS
DEVELOPMENT
DETAILS
DELIVERY
For any fuel from Crude Oil to Gasoline, any type, for any service, from farm to airplane engines.
Specialist on Two-Cycle
Submit Me Your Bearing Problems
Lock Box 1472, Cincinnati, O.

REBUILT DE HAVILAND -6- $1,500 2 PASSENGER
In perfect condition, ready to fly. Full set instruments 90 H.P. Curtiss 6x5 Motor. Will climb 2,000 ft. in 5 minutes. See this bargain before you buy.
RECONSTRUCTED DE HAVILAND -6- $1,800 3 PASSENGER
Brand New, A beauty to look upon - A wonder for performance. Will climb 2,000 ft. in 9 minutes with 700 Lbs. load. Will take off with 300 ft. run. Be quick if you want a good airplane at reasonable price.
WALTER SHAFFER AIRPLANE AGENCY, Dauphin, Pa.

LOS ANGELES—LAS VEGAS—SALT LAKE AIRWAY
The short line to the Pacific Coast.
Landing fields at Victorville, Yermo, Kelso, Calif.
Roach, Las Vegas, Dry Lake, Caliente, Nevada.
Lund Milford, Lynndyl, Utah.
For further information address,
BOB HAUSLER,
BOX 240, LAS VEGAS, NEVADA.

Ex-Pilot
U. S. Air Service
U. S. and Foreign
Patents and Trademarks
ALLEN E. PECK
Patent Attorney
29-31 Pacific Building, 622 F. Street, N. W.
WASHINGTON, D. C.

PHENIX FIREPROOF DOPE
on your plane will avoid the risk of FIRE spreading over the plane.
PHENIX FIREPROOF PAINT on the wood work prevents the burning of the wood.
Send for circular, samples and prices.
Aluminum and Clear
PHENIX AIRCRAFT PRODUCTS CO.,
WILLIAMSVILLE, N. Y.

WRITE FOR OUR SPECIAL PRICE LIST
CANUCK, JN., AVRO AND OX-5 PARTS
ERICSON AIRCRAFT LIMITED
120 KING ST., EAST, TORONTO, CANADA

"FOR SALE:
Curtiss Model F rebuilt Flying Boat Hull, standard wing section, in perfect condition. Will sell cheap to make space.
VENTNOR BOAT WORKS
336 Fifth Ave., Ventnor, Atlantic City, N. J."

CANUCKS AND SPARES AT BARGAIN PRICES
NEW WINGS . . . . $160 UPPERS / $140 LOWERS covered by Voisin.
New Rudders or Elevators $15
Radiators (used) - A-1 . . . . $20
Wing Covers - $15 ea. Dope - $2.50 per gal.
OX-5 Parts - 33 to 50 per cent off list
Why pay more? Get our cut-price list on Planes and Parts
REBUILT AND NEW CANUCKS $2000 TO $2500
DE LUXE AIR SERVICE, Inc., Asbury Park, N. J.

AERO CAMERAS
U. S. SIGNAL CORPS SURPLUS
For mapping and oblique work, can also be used as hand camera, box all metal, finished in olive drab, focal plane shutter, automatically set when changing plates. 4 x 5 size. Lens equipment 8½"F: 4.5 Tessar, 18 septum plate magazine and carrying chest. A $350.00 VALUE AT $140.00
Wire your order.
BASS CAMERA COMPANY
Aero Dept. 109 N. Dearborn St., Chicago, Ill.

INDEX TO ADVERTISERS

A

Aero Limited, Inc..... 573
Aeromarine Engineering & Sales Co..... 562-563
Aircraft Service Directory..... 576
American Legion—Air Service Post..... 574

B

Barker, Frederick W..... 578
Bethlehem Aircraft Corp..... 577
Brewster-Goldsmith Corp..... 578
Boeing Airplane Co..... 548

C

Culver Summer School..... 575
Curtiss Aeroplane & Motor Corp..... 580

D

Dayton Wright Co..... 547
Diggins, Ralph C., Co..... 578

F

Flottorp Manufacturing Co..... 578

H

Hartshorn, Stewart Co..... 578
Huff, Daland & Co., Inc..... 579

L

Laird, E. M., Aeroplane Co..... 579
Logan, Floyd J..... 577

M

Manufacturers Aircraft Association..... 574
Martin, The Glenn L., Co..... 550

P

Pioneer Instrument Co..... 575

R

Roebling's, John A. Sons, Co..... 578

T

Thomas-Morse Aircraft Corp..... 549

W

Wellington Sears & Co..... 578
Where to Fly..... 572
Wittemann Aircraft Corp..... 575
Wright Aeronautical Corp..... 546

Safety First!

The most essential requirements of a new commercial airplane are its overall

SAFETY FACTORS

Its reliability in operation.
Its economy in upkeep.

Its economy in upkeep, means Safety First on your investment; guaranteeing a profit.

Its reliability in operation, means Safety First in ever-ready service; guaranteeing constant business.

Its overall Safety Factor of 9, means Safety First in all flying positions; guaranteeing a safe landing.

Circular A. V. upon request
Distributor's Territory available

New York Office - - - - 52 Vanderbilt Ave.

BETHLEHEM AIRCRAFT CORPORATION

Bethlehem ..... Pennsylvania

COME ON LETS GO

MOTORS: - New OX-5's Complete $545
New OXX, 100 H.P., Complete $650
New K-6, C-6, Hispano, Beardmore or Mercedes Motors - VERY LOW

AEROPLANES: - Canucks, JN4D's and J-1 Standards, with OX5 Motor, ready for flight or boxed and on cars $1875 to 3150
New J-1 Standard, less motor, ready for OX, FOB Houston 1400
New J-1 Standard, as is, less motor, unchanged FOB Houston 1000
New J-1 Standard, with K-6, C-6, Hispano; Beardmore or Mercedes, all new motors, 2 or 3 place, $3350 to 6450
Curtiss Oriole, New, with new C-6 Motor, 3 place - a beauty 8600

PROPELLERS: - For All Type Motors - specially low prices; For OX5: - CAL $20; Paragon Variable Pitch $45; Buffalo Mahogany $51; Flottorp or Hartzell $55.
For Hispano 150 H. P., $75; for Hall-Scott A7A and Curtiss OXX $65 (All metal Tipped except CAL and that is a dandy at $20)

HEADQUARTERS: - For Brand New Wings all covered for Canuck and JN4D $165; for J-1 Standard $175.
Also Complete Spare Parts for Canuck, JN4D, J-1 Standard, F Boat and OX5 Motor.
Grade A Mercerized cotton 55c yd.; 1st class linen 90c yd.; New Nitrate Dope Guaranteed $2.75 for 1 gal.; $11.50 for 5 gals,, including dandy can; in bbls. $1.85 per gal.

Wing Cover: - Canuck or JN4D, Upper, Linen $25; Lower linen $17. Upper cotton $17; lower cotton $15. Tape, cotton pinked 6c yd.; Tape, Linen pinked 9c yd.; shock absorber cord, good, 45c yd.; New 26 x 4 inner tubes $1; Goodyear 26 x 4 slightly used casings $5.50; tachometer heads $15; altimeters, dandies, $38; NAK Resistol Goggles Non-Shatterable $10; Leather Helmets, Summer weight $5.50; Heavier $6.50 (What size?)

ALSO HAVE SOME DANDY BUYS IN FLYING BOATS

Largest Variety Reasonable Prices Promptest Shipments

AM shipping all over U. S. If speed and quality desired, TRY ME.

FLOYD J. LOGAN

712 SUPERIOR N. W., CLEVELAND, OHIO

The Spark Plug That Cleans Itself

B. G.

Contractors to the U. S. Army Air Service & the U. S. Navy

THE BREWSTER-GOLDSMITH CORP.
33 GOLD STREET
NEW YORK CITY U. S. A.

LEARN TO FLY
IN CHICAGO

America's Foremost Flying School
Third Successful Season
Students Now Enrolling For Spring Classes
Best Airdrome in the U.S.
Aero Club of IllinoisField
Thorough Ground Mechanics & Flying Training
Dozens of satisfied Graduates our best recommendation.

Write at once for interesting description of flying school and our splendid enrollment offer.

THE RALPH C. DIGGINS CO.
140 N. Dearborn St., Dept. C CHICAGO

FREDERICK W. BARKER
REGISTERED PATENT ATTORNEY
2 RECTOR STREET NEW YORK
Telephone 4174 Rector *Over 30 Years in Practice*

PRESIDENT
AERONAUTICAL SOCIETY OF AMERICA
FROM 1915 TO 1919

SPECIALTY: Patent Claims That Protect

AMPHIBIOUS LANDING GEARS
Write for full particulars
ALEXANDER KLEMIN AND ASSOCIATES
Consulting Aeronautical Engineers
22 East 17th Street New York, N. Y.

HARTSHORN STREAMLINE WIRES

Assembled with Hartshorn Universal Strap Ends make the Ideal Aeroplane Tie Rods—diminished wind resistance insuring greater speed.

This fact was proved in the speed test for the Pulitzer Trophy. Four of the first five ships were equipped with Hartshorn Streamline Tie Rods.

Write for circular A-1 describing our Wires and Strap End Fittings.

STEWART HARTSHORN CO.
250 FIFTH AVENUE, NEW YORK

Flottorp Manufacturing Co.
AIRCRAFT PROPELLERS
Established 1912

213 Lyon St., Grand Rapids, Michigan

Contractors to United States Government

ROEBLING

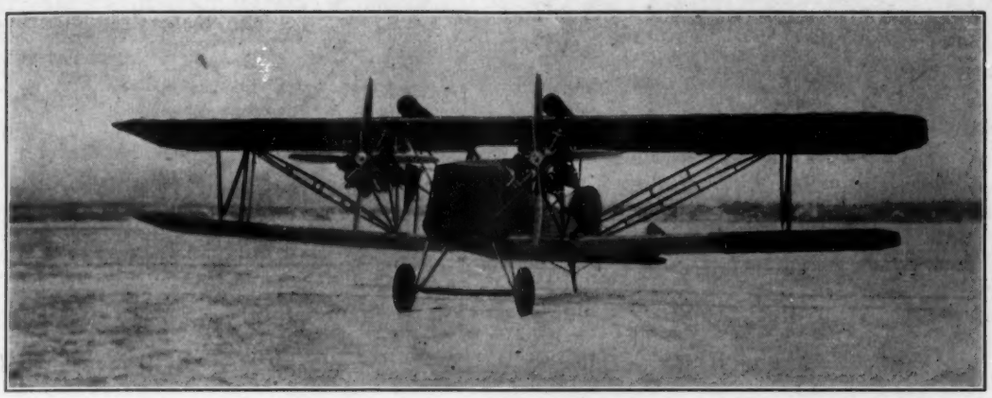
19 Wire Galvanized Aircraft Strand—Sizes 1/2" - 1/16"
Standard Tinned Aircraft Wire. B & S. 0 - 24
6 x 7 (Cotton Center) Galvanized Aircraft Cord 1/2" - 1/16"
7 x7 (Wire Center) Galvanized Aircraft Cord 1/2" - 1/16"
7 x 19 Tinned Aircraft Cord 1/2" - 1/8"
Standard Galvanized Steel Aircraft Thimbles 1/2" - 1/16"
Standard Steel Aircraft Ferrules. B & S No. 6 - 20

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY.

Warwick NON-TEAR *Aero-Cloth*

A SAFE CLOTH *for* FLYING

For Particulars Apply to
WELLINGTON SEARS & CO.
66 Worth Street, New York



THE EARLY BIRD (HD-1 B)

OUR AIRPLANES ARE PRODUCED BY MEN EXPERIENCED IN THE DESIGN AND CONSTRUCTION OF COMMERCIAL AND WAR TIME AIRCRAFT OF ALL TYPES

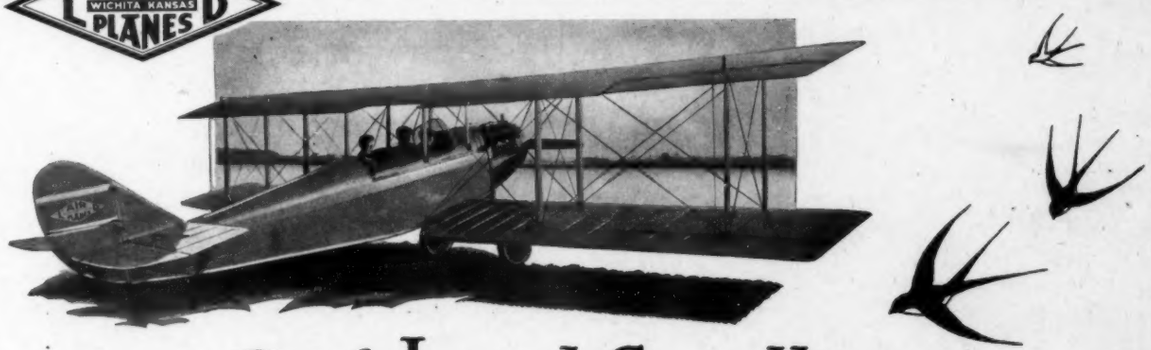
Type	Weight Full Load	Useful Load	Motors	Number of Motors and H.P.	Lbs. per H.P.	Lbs. per sq. ft.	Selling price without motor	Selling price with motor
HD-1B	2850	5 seats 1100 lbs.	10 cyl. Anzani	2-100 200	14.1	6.5	$4,500.	$5,700.
HD-4B	1940	2 or 3 seats 740 lbs.	10 cyl. Anzani	1-100 100	19.4	5.8	$4,200.	$4,800.

HUFF, DALAND & CO., INC.

OGDENSBURG, NEW YORK

AIRPLANES FLYING BOATS MOTOR BOATS

LAIRD AIRPLANES WICHITA KANSAS



The Laird Swallow

"America's First Commercial Airplane"

COMMERCIAL airplanes must combine dependable performance with real economy of upkeep and operation. The large carrying capacity of the Laird "Swallow", its small over-all dimensions, light weight and great performance on a minimum of power, adapt it for *profitable* commercial use. The new Laird "Swallow" Booklet explains why these airplanes are most profitable for distributors. Some good territory still open. Use the coupon.

E. M. LAIRD COMPANY

MANUFACTURERS

WICHITA, KANSAS

General Sales Offices

2216 SO. MICHIGAN AVE., CHICAGO.

E. M. Laird Company,
2216 So. Michigan Ave., Chicago, Ill.
Please send the undersigned a copy of your new booklet on The Laird "Swallow"
Name .....
Address .....
.....

CURTISS AVIATION FIELD

MINEOLA, LONG ISLAND, N. Y.

The best equipped flying field in the country
Former U. S. Government Airdrome, Hazelhurst Field
The center of Aviation Activities; one hour from New York

NEWEST TYPES OF *CURTISS* AEROPLANES,
PASSENGER CARRYING, CROSS COUNTRY,
AERIAL PHOTOGRAPHY, ADVERTISING,
SERVICE STATION, HANGAR SPACE.

Special Facilities for Motion Picture Work

FLYING INSTRUCTION
AT
CURTISS AVIATION SCHOOL

Best Methods, Based on Eleven Years of *Curtiss* Experience in Training Aviators. Thorough Instruction in Theory and Practice. Reasonable Rates. After Qualifying, Students may Arrange for Solo Flying. No Breakage Charge. Students See Planes under Construction in *Curtiss* Factory, and many Types in Use.

WRITE FOR BOOKLET AND RATES.

CURTISS AEROPLANE & MOTOR CORPORATION

GARDEN CITY, LONG ISLAND, N. Y.

We Have Ships of All Types for Sale and Immediate Delivery